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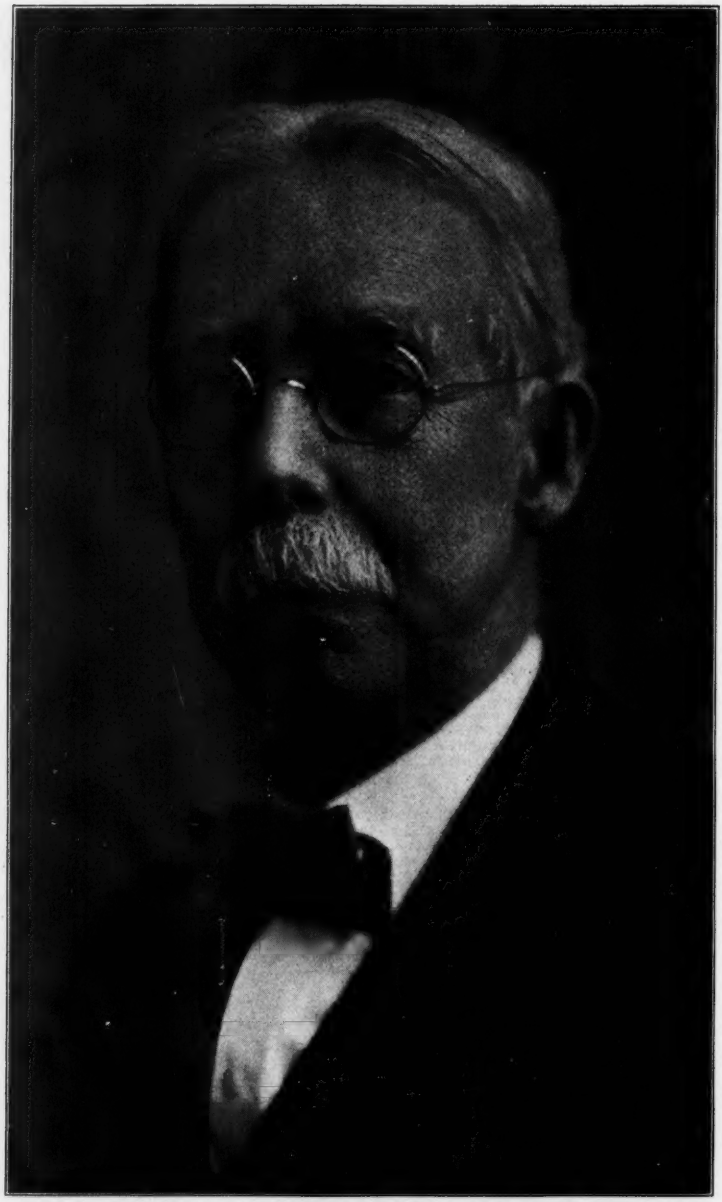

EDMUND NOYES, D.D.S., F.A.C.D.
(1842-1927)

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## *Original Communications*

# SOME DISEASES OF THE SOFT TISSUES OF THE MOUTH, WITH DIFFERENTIATION BETWEEN THOSE OF PRIMARY AND THOSE OF SECONDARY ORIGIN*

By THOMAS L. GILMER, M.D., D.D.S., Chicago, Illinois

IT is not generally recognized that, to the square inches of area involved, the mouth contains a greater variety of diseases than any other region of the body. Therefore, since the mouth is the dentist's field of observation and care, he should, as far as possible, be informed regarding these diseases. It is not possible to discuss, in a paper of this kind, all of the diseases of the mouth. If your attention is called even to a few of the most important ones, their discussion must of necessity be cursory.

As Dr. Pusey once said, the mouth is a field where dermatology and stomatology overlap in a very intimate way. This is likewise true of rhinology, though in a less degree.

For convenience, oral diseases may be divided into two groups: (1) those that are specifically primary in the mouth; (2) those constituting part of the picture of an extra-oral disease with secondary manifestations in the mouth.

In the first group mentioned, we have, as one of these primary oral lesions, aphthous stomatitis, commonly called thrush, which usually occurs in infancy, but, as Osler says, occasionally is found in the mouths of debilitated adults.[1] It is a parasitic disease, sup-

*Read before the Midwinter Clinic of the Chicago Dental Society, Jan. 26, 1927.

1. Osler, William: Modern Medicine, Vol. 3, p. 46.

posed to be due to the fungus oidium or *Saccaromyces albicans*. The aphthae are shallow ulcerations covered with white films, found on the fauces, the soft palate, gums, tongue and other parts of the mouth.

Another primary oral disease is acute ulcerous gingivitis, which I first described and named in 1906.[2] It is called ulceromembranous gingivitis by Weaver and Tunnicliff; and by others "trench mouth." Occasionally, it is called Vincent's disease, and by some, improperly, Vincent's angina.

This disease was uncommon before the World War. One might not see a case in a large practice in many years. Our soldiers contracted it in France, and, on returning to this country, spread it widely. It is an ulceration of the gingival borders of the gums, usually appearing first about the necks of the incisor teeth, later about all the teeth. If one suffering from pyorrhea contracts this disease, the ulceration extends rapidly toward the apices of the teeth, causing them to become loose, and, as a result, they are frequently lost. The disease appears as rather deep ulcers but rarely involves the bone. The ulcers are overlaid with a grayish white film, similar to that found covering syphilitic mucous patches. When this covering is removed, a raw surface is exposed, which is extremely sensitive to touch. Salivation is present and generally the submaxillary lymphatics are involved. The patient usually has a slight rise in temperature and frequently is melancholic. The appetite is diminished, and food is taken with difficulty, owing to the sensitiveness of the ulcers. The breath is always fetid, owing to the presence of *Bacillus fusiformis* and spirilla.

Dr. Ruth Tunnicliff positively demonstrated *Bacillus fusiformis* and spirilla as the cause of the disease.[3]

Another allied disease is Vincent's angina, found in the tonsils and fauces. It is due, as is acute ulcerous gingivitis, to Vincent's organism, the fusiform bacillus and spirilla, and has many of the characteristics of the gum disease just described.

The anaerobe *Bacillus fusiformis* and the spirilla, growing symbiotically with the hemolytic streptococcus, are found in those infections occurring at the angle of the jaw, in floor of the mouth, and in the submaxillary gland region, causing a hard brawny swelling, a cellulitis, known as Ludwig's angina.

Herpes labialis, commonly called cold sores or fever sores, is a disease of the lips too well known to need description. A counterpart of this disease, found in the mouth, is called canker sore. The mouth lesions are small superficial ulcers, very sensitive to touch. It is believed that fever sores and canker sores of the mouth are etiologically the same; that is, a neuritis of toxic origin in the peripheral terminal nerves of the affected part. The mouth ulcers are called herpes simplex. Some individuals are more often subject than others both to herpes of the lips and to canker sores. It is not uncommon to see a crop of herpes of the lips following dental operations, due not, as the patient often thinks, to infected instruments, but to slight trauma

2. Gilmer, T. L.: Dent. Rev., May, 1906.

3. Tunnicliff, Ruth: Fusiform Bacilli and Spirilla, J. Infect. Dis., April, 1911.

resulting from the stretching and injury of the parts.

Diphtheria, an acute infectious disease, attacks the tonsils, throat and lips and other parts of the mouth. This disease is caused by the Klebs and Loeffler bacillus. It is indicated by a white false membrane covering the parts involved. It is very toxic but is amenable to antitoxin treatment, if taken in time.

Lichen planus is not infrequently seen in the mouth. It appears, Pusey states, "as inflammatory papules with a grayish surface like points that have been touched with nitrate of silver."

Purpura haemorrhagica is seen as ecchymoses in the mucous membrane coverings of the mouth, which do not disappear on pressure. Hemorrhages may accompany the disease. Purpura of the skin may or may not precede the mouth symptoms. Purpura is seen secondary to such diseases as scarlatina, variola and other diseases having skin symptoms. It occasionally causes sloughing of the mucosa.[4] Holt reports one case in which the soft palate was destroyed by this disease.

Primary tuberculosis of the mouth is rare. I have seen but one case that could have been definitely of primary oral origin. It is usually found secondary to pulmonary tuberculosis, or the mouth involvement is transmitted through continuity of tissue from lupus of the skin adjacent to the lips. I have seen but two other cases of tuberculosis of the mouth. In these, the diagnosis was easily made from the fact that the patients were definitely tuberculous. Tuberculous ulcers of the mouth are distinguished from syphilitic ulcers by the fact that the former are extremely sensitive to touch and have rough edges, while syphilitic ulcers are less sensitive and have well-defined thickened margins. Moreover, tuberculous ulcers do not respond to antisyphilitic treatment.

Primary expression of acquired extragential syphilis is found on the lips, tip of the tongue and pharynx. In these locations, chancre may appear first as a papule, which later ulcerates. Indurated neoplastic areas surround the chancre. The lymphatics, submental or submaxillary, whichever are associated with the area infected, are soon involved, enlarge and become indurated. Multiple chancre is rare in the mouth, but is sometimes seen and is due to two or more infections at the same time.

When chancre of the lips and tongue becomes eroded and ulcerates, it enlarges and may simulate epithelioma, but the much more rapid growth of chancre, together with the earlier involvement of the lymphatics, the age of the patient and the absence of the characteristic odor of ulcerating carcinoma, serve to aid in differentiation. In case of doubt, the Wassermann test, the microscope and antisyphilitic therapy will give a positive differentiation. Up to about the sixth to twelfth week after the appearance of the chancre, the physical condition of the patient may remain normal, when, if no treatment has been instigated, the secondary stage will appear, indicated by fever and rash, or rash preceding fever. Simultaneously with the rash and fever, mucous patches develop on the lips, tongue, soft palate and the inner surface of the cheek, or,

4. Holt, L. E.: Diseases of Infancy and Childhood.

indeed, on any part of the mucosa of the mouth, regardless of whether the disease originates primarily or secondarily in the mouth. Mucous patches also differ from canker sores in that they have more clearly defined margins and are not so painful to touch, and the immediate area is not so hyperemic.

There are other infections that are primary in the mouth, but they cannot be included here.

Other distinctly primary oral disease manifestions are the neoplasms. Among the most common of these is the so-called epulis, a benign fibrous tumor, usually pedunculated, and generally seen on the gums in the labial region of the jaws. It springs from the connective tissues of the periosteum or peridental membrane and grows to considerable size at times. It should be removed, since it may become malignant.

Angioma is found in the tongue and other parts of the mouth. It is also a nonmalignant growth, bluish, and made up principally of enlarged veins or lymph vessels. Since this neoplasm grows to large size, it is subject to injury, and therefore should be removed early. Occasionally, serious hemorrhages follow injury to these growths.

Another nonmalignant tumor of the mouth, called a mixed cell tumor, is found in the tissues overlying the hard palate, and in the soft palate. It is a smooth, rather hard encapsulated growth, unilaterally placed, and composed of salivary glandular and other tissues. It does not break down and ulcerate as does the gumma of syphillis.

Another nonmalignant growth, an exostosis, under the title of this paper should not properly be enumerated, but is given for differentiation since it has been mistaken for a malignant neoplasm. It is found in the median line of the hard palate and on the lingual surfaces of the mandible in the bicuspid region. It may grow to considerable size, but does not require removal unless the mouth becomes toothless and therefore demands artificial dentures. In such case, if the growth is excessive its removal may be necessary.

Papillomas are found in the soft tissues overlying the hard palate, on the buccal mucosa and on the tongue. These growths are small and resemble warts of the skin. They should be removed, since as a result of irritation, to which they are constantly subject, it is supposed that they may become malignant.

Hyperplasia, caused by ill-fitting artificial dentures, is not uncommon. The hyperplastic areas are usually seen on the upper jaw, after long continued use of temporary artificial plates, and where there has been excessive shrinkage of the alveolar process, the ill-fitting plate irritating the soft tissues cause hyperplastic growths. All such growths should be removed, and the patient should be supplied with perfectly adjusted plates.

Aneurysm of the posterior palatine artery is occasionally seen and mistaken for an alveolar abscess. I once saw such an aneurysm in consultation that had been lanced by the patient's dentist, he supposing that he was dealing with an abscess. When the tumor was lanced, arterial blood instead of pus, spurted from the incision. To differentiate between an abscess and an aneurysm, pressure is exerted distally to the tumor; and if it decreases in size, an aneurysm is indicated. If the finger is placed on one side of the enlargement and the thumb on the opposite side, and pressure is exerted, a pulsation will be

felt that not only raises the thumb and finger, as in the case of an abscess, but perceptibly separates them. To differentiate positively, a part of the contents of the enlargement should be aspirated.

We turn now to the discussion of malignant growths, which rank high as the cause of death. Statistics show that nephritis ranks first, cardiac diseases second and cancer third, in their fatality. Dr. Francis Carter Wood of Columbia University, in a recent address before the Chicago branch of the American Association for the Control of Cancer, said that physicians are often derelict in their duty to their patients' welfare in treating lightly certain lumps in the breasts of women and growths in other parts of the body of both sexes, since early removal of such growths is the only safeguard in the control of cancer.

This applies equally to the dentist, who, I fear, does not always scrutinize every part of his patient's mouth to discover whether there may not be conditions which, though not malignant at the time, may become so. If he does not feel that he is qualified to judge of the nature of the abnormal condition found, he should send the patient to one who is qualified. All new growths should be considered precancerous, since it is well known that early removal of cancer means permanent cure, while delay means much suffering and death. Blair says that it is generally conceded that if cancer is removed thoroughly in its incipiency, practically 100 per cent cures should be expected.[5]

Not long since I saw a patient whose condition, involving loose teeth and inflamed gums, was attributed by his dentist to pyorrhea, and pyorrhea treatment instituted. When I saw the patient, the disease, carcinoma, had so far progressed that the cervical lymphatics had become involved. The patient died. Had the disease been early recognized, a life might have been saved.

Carcinoma and sarcoma, two malignant growths of the mouth, differ in that, with rare exceptions, carcinoma of the mouth is found only in individuals beyond middle life, while sarcoma may occur at any age. It is not possible to picture either of these growths in words. They must be seen often for recognition, and, even then mistakes may be made in diagnosis. The microscope and a Wassermann test may be necessary for differentiation.

Carcinoma may attack any part of the epithelial tissues of the mouth. Most of the cases that I have met seem to have originated in the sulci at the duplicature of the mucosa and gum. Leukoplakia lesions on the tongue or other parts of the mouth tend to become carcinomatous. When a carcinomatous growth has attained some size it tends to assume a cauliflower appearance. When it ulcerates, it has a distinctive odor, and the patient generally experiences much pain. The cervical lymphatics sooner or later become involved, either from the infection or in secondary carcinomatous growths.

Sarcoma of the mouth, except in connection with the bones of the jaws and periosteal tissues, is uncommon. The spindle and round cell sarcomas are malignant; while the giant cell or myeloid growth is not malignant in the sense that it causes metastasis. The more rapidly growing carcinomas and sarcomas are the most malignant.

While cysts are not, strictly speaking, tumors, they should be mentioned in this connection. There are two kinds

5. Blair, V. P.: Internat. Abstr. Surg., February, 1916.

of cysts found in the mouth, the mucous and the dermoid. The most common of these is the muciparous cyst of the lip. It is a retention cyst, appearing as a bleb filled with transparent mucus, and caused by occlusion of the mucus ducts. It is so distinctive in appearance that it cannot be mistaken. It is about the size of a pea. A simple puncture of the cyst wall evacuates its contents and causes it to collapse, but unless the mucous gland connected with it is dissected out, it soon fills again.

A ranula is a cyst in the floor of the mouth, generally unilaterally placed. It is not, as once supposed, due to obstruction in the duct from the submaxillary or submental salivary glands, but to atresia of the ducts from the mucous glands in the floor of the mouth. It is similar in appearance to muciparous cysts of the lips, but becomes much larger.

Another mucous cyst of the mouth is found on the under surface of the tongue in the median line just back of its tip. It is likewise a retention cyst, due to the occlusion of the duct from Blandin and Nuhn's gland. These are extremely rare.

Dermoid cysts are found in the floor of the mouth, and are probably due to fetal inclusion of epidermal tissues. Those that I have seen contained only thick sebaceous matter, which, having no normal outlet, causes the formation of a cyst increasing in size with the increase of the sebaceous material. Occasionally, these cysts contain hair. Palpation of a dermoid cyst gives a different sensation from that felt when a ranula is touched. The latter feels like a small, thin tissue bag filled with water, while a dermoid cyst feels more like a similar bag filled with soft putty. On removal of the finger from a dermoid cyst, a depression remains.

Calcareous deposits are not infrequently found in Wharton's and in Stenson's ducts. They are discoverable through the use of the probe, by palpation or by the radiogram. They should be removed, since they may occasion infection in the duct, especially if the concretion has a rough surface.

Many extra-oral diseases are reflected in the mouth; for instance, syphilis, the Koplic spots of measles on the buccal mucosa, the strawberry tongue of scarlet fever and some erythematous diseases such as smallpox, and chickenpox. Ulcers in the mouth generally accompany pernicious anemia, and if no other cause for them is found, pernicious anemia should be considered.

Sprue, a tropical disease, is occasionally seen in more northerly latitudes. Ulcers similar to those accompanying pernicious anemia are found in the mouth in connection with this disease.

Secondary oral manifestions of syphilis or mucous patches are most commonly seen in the buccal mucosa and fauces. The ulcers are overlaid with a grayish white film. The margins are well defined and slightly elevated, differing from tuberculous ulcers of the mouth, which as before said, have rough edges, "mouse-gnawed" as they are designated. They are less sensitive to touch than tuberculous ulcers.

Among those diseases that may be either primary or secondary in the mouth are chancre of syphilis, and, occasionally, gonorrhea. From more recent writers, I have observed that lupus erythematosus and other erythematous disease may be differentiated with difficulty from pemphigus and syphilis. Early symptoms of pemphigus are seen in the mouth as bullae. These coalesce, with

desquamation of the surface epithelium. It seems probable from the literature and from the few cases[6] that I have seen that the oral symptoms of pemphigus are probably a part of a picture of a general disease. An exception may be made in that form of the disease known as pemphigus vegetans, which, according to Goadby,[7] occurs on the lips, gums, and other parts of the mouth as small whitish or reddish bullous plaques. He says, "The base of the patch becomes edematous, thickened and inflamed and covered with an offensive viscid secretion." Pemphigus is generally recognized as a disease with bad prognosis.

A tertiary oral manifestion of syphilis is the gumma, which is most commonly seen as nodes in the hard and soft palate and on the tongue, later breaking down from ulceration. If the primary disease is not checked by treatment, the ulceration may destroy not only the soft tissues involved, but the bones of the upper jaw and nose as well.

There are two conditions found in the mouth, and called leukoplakia, that experience leads me to believe are different, both clinically and etiologically. In true leukoplakia, these are dead white rather hard patches with definite outlines, which are permanent; while, in the other disease, the patches are less white and are diffused generally over the tongue, floor of the mouth and oral mucosa. The latter is more like a film than the condition found in true leukoplakia, and is transitory, disappearing without treatment.

Primary and secondary diseases of the tongue are so numerous that a book of many pages would be required to do justice to them. A book of 383 pages, written many years ago by Butlin, is still a classic on that subject. Glossitis is a word applicable to a multitude of tongue diseases.

Black tongue, hairy tongue, geographic tongue, and Moeller's glossitis are only a few of the numerous diseases of the tongue. The tongue often reflects gastro-intestinal disturbances and other diseases. Formerly, the physican having no laboratory help had to employ other means as aids to diagnosis. The tongue was then universally examined. Tongue and gum examination may still be helpful, if properly conducted.

The gums are subject to a variety of changes and diseases, and except for those due to lack of personal care, calcareous deposits, sharp edges of broken teeth, clasps of partial dentures and poorly fitted orthodontic appliances and bad approximal tooth contours, gum changes are usually secondary to other diseases.

Dietary insufficiency, as shown by the lack of certain vitamins, is notably illustrated in scurvy, and this deficiency, without doubt, causes other gingival diseases. Metallic poisons, such as lead, bismuth and mercury, are well known causes of inflammatory changes in the gums. Pregnancy, in its later stages, especially if albumin is found in the urine, is frequently accompanied by gingivitis. If an epulis exists at the time of pregnancy, the tumor takes on the same swollen hyperemic condition existing in the gums. After parturition, the gum symptoms subside and the tumor decreases in size.

A gingivitis of the gums, unlike the congested condition associated with pyorrhea, is often mistaken for that disease, and unsuccessfully treated as

6. J. Dermatol.

7. Goadby, K. W.: Diseases of the Gums and Oral Mucous Membranes.

such. It appears as a brilliant red inflammation at the gingival border, the area bleeding on being touched, but does not involve the peridental structures. It may be found even in the mouths of those who are careful of mouth and tooth hygiene. Blood examination and urinalysis give no clue to the cause. Dietary changes have been helpful in some cases, but as far as I have been able to discover, no definite cause or cure for the condition have been found. Here is opportunity for research.

DISCUSSION

*William Allen Pusey, Chicago, Ill.:* Dr. Gilmer has covered an enormous amount of material tonight, and nobody else could do it so well. There is no reason for me to discuss it, except to express in general my appreciation of it, and to emphasize some of the points he has made. But I have learned so much from Dr. Gilmer about the mouth, I have had so much satisfaction in being, in a way, a pupil of his for twenty-five years, that it always gives me great pleasure to discuss a paper of his. He spoke, I think, of stealing something from me, in this paper. I'll tell him right now that I wish he would steal more, because then perhaps my conscience would be easier as regards the amount that I have stolen from him. The mouth and the skin practically represent the same structures, as far as eruptions are concerned. The only difference is that, in the mouth, the lesions are affected by maceration from moisture and heat, and therefore changed; but many of the conditions, a large part of the lesions that occur in the skin, occur as well in the mouth; therefore, stomatology and dermatology overlap here. Dr. Gilmer divides the diseases of the mouth chiefly into those that represent manifestations of systemic conditions and those that are local to the mouth, a good division. It is interesting from the standpoint of dermatology to start with the skin diseases that in the mouth are simply manifestations of general processes. The best illustrations of these are the exanthems. They practically all occur in the mouth, and just as they do on the skin. We see the same tendency for skin eruptions to occur in the mouth in many other diseases that are much more purely skin diseases. In all the group of toxic eruptions, the typical picture is toxic erythema, and these toxic erythemas, just as the exanthems, appear in the mouth right along. A little further on, we find the condition that we call pemphigus, which dermatologists have lately learned to recognize as commonly a disease of the mouth. Duhring's disease, dermatitis herpetiformis, which is closely allied to pemphigus, for some reason or other does not develop in the mouth so commonly. We have another expression of these toxic processes, often infectious, in the eruptions in the mouth of purpura, which is simply an extreme manifestation of the same sort of thing that we see in erythema multiforme. This group can be extended indefinitely. After erythema multiforme, purpura and pemphigus come diseases manifesting themselves in the mouth that are not so definitely systemic but that, in all probability, are systemic. The best illustration of these is lichen planus, which, as we have learned, now often occurs in the mouth before it appears anywhere else, and lupus erythematosus, which occurs also in the mouth in the same way. Certain diseases fail to appear in the mouth; for example, dermatitis herpetiformis, which is practically never found in the mouth, although its relationship to pemphigus is extremely close. Erythematous lupus appears in the mouth, but psoriasis and seborrheic dermatitis, both of which resemble it closely, do not occur in the mouth, and I have an idea that in that fact we get some clew as to the nature of these conditions. The theory that psoriasis does not occur in the mouth, while lichen planus does, because psoriasis probably is a local disease and lichen planus a general disease can easily be controverted. In this way, we see many analogies and a good many differences between dermatoses as respects their manifestation in the mouth. The dermatologist, as a rule, in many of these conditions could not make the diagnosis of the condition in the mouth if there were not lesions also on the skin. For example, it is extremely difficult to distinguish the lesions of erythema multiforme in the mouth from syphilitic mucous patches, and practically impossible to tell them from the lesions of pemphigus if there were not lesions on other parts of the body; and that suggests a rule that we can observe with great profit in studying these manifestations in the mouth of

diseases that occur on the skin elsewhere. We must rely largely on the picture of the skin condition to make the diagnosis of the condition in the mouth. That applies also to syphilis. Occasionally, the lesions in the mouth are sufficiently characteristic to afford a diagnosis. We can often make a diagnosis of lichen planus in that way. Syphilis gives the complete picture of manifestations of skin diseases in the mouth. It begins with a chancre. That is a perfect picture of a local infection as it occurs on the skin and in the mouth. The chancre has a definite clinical appearance, when it is definite, but we have learned, in the last twenty years, that the chancre is frequently disguised. If there is one practical lesson we have learned more than another about syphilis, it is that any lesion that from its history might possibly be a chancre should be suspected of being syphilitic. I mean by that that the chancres on the genitals and in the mouth may be so disguised that they would be overlooked unless we look for them; and so it has come to be our view that the diagnosis of a chancre, which is very important to the patient, and certainly to the dentist who is treating him, should be made with a microscope. The diagnosis is made by demonstrating *Spirochaeta pallida*, and that can be done definitely by men who are expert in identifying *Spirochaeta pallida*. It is somewhat confusing because the *Spirochaeta microdentium* resembles it. After chancre, we have secondary lesions of syphilis, and, in the mouth, they are exactly the same as the secondary lesions of syphilis on skin surfaces, except as they are modified by heat and moisture. The secondary lesions of syphilis in the mouth are, of course, the mucous patches, practically never any other lesion. I have no hesitation in saying to the dentist that, as regards diseases of the mouth and the danger the dentist runs, the most important thing is mucous patches in the mouth of patients. A chancre is an obtrusive lesion, as a rule. If it is about the mouth, it is usually associated with big glands, and a suggestive, ugly appearing lesion. Mucous patches may be so abundant as to fill the mouth with these gray, pellicle-covered excoriations, extremely minute and extremely difficult to find. Nevertheless, the mouth condition is just as contagious as syphilis ever is. There is nothing more important than for the dentist to be able to recognize mucous patches. These are not to be recognized purely on their local appearance. I think nobody could make a certain diagnosis of syphilis from mucous patches with other indications present, but, fortunately, with mucous patches there are nearly always other diagnostic factors. In the first place, in mucous patches, we find spirochetes. In the early patches, they are abundant, but in any they can be found by search. In the next place, if a patient has mucous patches, he almost surely has some secondary eruption of syphilis on the body. In the next place, the patient who has mucous patches, if he tells the truth usually has some history to lead us to look for them. If I put over one point tonight, to the effect that the thing of all others for the dentist to look out for in the mouth, as far as his own protection is concerned, is mucous patches, these desultory remarks will be worth the listening to. How can the dentist guard against this condition? One way for him to protect himself with reasonable safety is to keep his hands free from abrasions or fissures. The great danger lies in fissures around the nails: if they are present, he is in danger. If there are no abrasions in the epidermis, there is no danger. Spirochetes cannot penetrate the unbroken epidermis, and so there is nothing more important to the dentist than keeping his hands free from fissures. I see no possible way that the dentist can avoid occasional exposure to syphilis of the mouth from mucous patches, and these mucous patches are dangerous, the most dangerous lesion of syphilis to other people. After the early period of syphilis comes the chancre, which may occur in the mouth or on the lips; that is, a local lesion. Then there are the mucous patches, which are manifestations of syphilis of a generalized systemic condition. The mouth is one of the commonest locations for the late manifestations, the gumma, evidence of a localization of the disease. Syphilis, in its secondary period, is a systemic disease with spirochetes circulating in the blood, though not abundantly. The weeping lesions of secondary syphilis are always extremely dangerous. As I said, the gumma represents localized syphilis. The patient no longer has spirochetes in the blood, or systemic manifestation of the infection, but localized foci of the disease. A gumma in the mouth is a local focus of syphilis and I would emphasize that a gumma

practically offers no danger. I think that no one was ever infected from a gumma in old syphilis. That is contrary to a common impression. Two of the commonest things brought home to us in syphilis is the lack of knowledge of the few important things that are dangerous, and the complete lack of knowledge that results in fear about manifestations of syphilis that are utterly harmless. Late syphilis, syphilis 5 years old, is not dangerous to anybody, and such syphilis in the mouth is perfectly free from danger. I have talked a little longer on syphilis than on anything else because syphilis is, from the dermatologist's standpoint, the important disease of the mouth, the disease that exemplifies all the diseases of the mouth that occur on the cutaneous surfaces. The local conditions of the mouth that Dr. Gilmer touched on are equally interesting, and equally show analogies in the skin. Dr. Gilmer expressed my views about leukoplakia, but I go a little further than he does. To my mind, leukoplakia is simply a symptom. It is not a specific disease. There is one form of leukoplakia which Dr. Gilmer referred to in which there are sharply defined thick white patches; that is, specific; but I don't know what it is. I don't mean specific in the sense of syphilitic, but all the rest is to my mind simply a chronic manifestation of inflammation. A leukoplakia may arise from a rough tooth, at the corner of the mouth for example. That is simply like a corn, it represents a reaction to friction. Of course, the most extensive cases develop from syphilis, and perhaps the most cases of carcinoma develop from these leukoplakias. In my experience, the sort of leukoplakia that precedes cancer is, as a rule, the extensive, ugly, leukoplakia. The small gray patches that are found in the mouth are not very uncommon. They often disappear just as do other lesions produced by some local irritant, and they are not dangerous. But in the sclerosed tongue, with thick patches of leukoplakia that persist year in and year out, there is danger of carcinoma.

# INDICATIONS FOR THE TREATMENT OF MALOCCLUSION*

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IN this study of the indications for orthodontic treatment, it is obviously impossible to consider all the many conditions of malocclusion of the teeth and abnormal development of the jaws. The following, therefore, will be omitted: abnormalities in adults, cases complicated by supernumerary teeth, so-called "congenitally" missing teeth, permanent teeth lost by extraction, transposed teeth, broken teeth, teeth of abnormal form or size, unerupted and impacted teeth other than cuspids, abnormal fraenum labii, cleft palate, pathologic conditions, abnormal metabolism and abnormal function of endocrine glands. Cases of malocclusion that are the result of one or more of the foregoing factors require careful, individual study, and logically should not be generalized on. Methods of treatment also will not be considered, for, as yet, there is no standardization of methods, appliances or technic, and different orthodontists of the highest caliber obtain good results through various methods.

It is my intention to consider and discuss the indications for orthodontic treatment of average cases during the period of rapid growth and development of the teeth and jaws, or from birth to the eruption of the cuspids and second molars, usually about the twelfth year.

It is generally conceded that the idea of early orthodontic treatment is correct. If we are able to improve the development of the jaws early in the development of the individual, there will be better development of the associated tissues, and consequently a more harmonious end result than if treatment is deferred. Our efforts should always be to produce a development of the jaws and dental arches that will be normal for the individual at his particular age or period of growth, so that, as a final result, there will be normal occlusion. As the stress of normal mastication is an extremely important factor in the development of the entire lower half of the face, it is necessary for the patient to be able to masticate properly while this development is progressing, or the final result will not be what Nature intended for the individual. Hence, early treatment, keeping pace with the natural process of development, is indicated in every case, so that we may have a normal and harmonious general development of the face as well as a chewing mechanism that functions normally as a result of our treatment. Unfortunately, the majority of cases of malocclusion for which treatment is sought have pro-

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gressed beyond the time when the most effective treatment can be applied. In spite of this handicap, many cases can be so treated that a fairly normal result is obtained.

The main problem is one of bone growth; we must help the alveolar process to develop normally, in both character and form, to accommodate and support the teeth in normal occlusion. To obtain and maintain such a result, it is essential that all tissues that are associated by location, or have an influence through their function, be normal also.

A general rule in orthodontics is that "malocclusion should be treated as soon as manifest." The idea that such a statement is intended to convey might be expressed more accurately by saying that "as soon as it is apparent that abnormal development of the dental arches is taking place, corrective measures should be instituted." To illustrate this point, we may consider a lower dental arch from which all deciduous incisors have been lost and in which no permanent incisors have yet erupted. If such an arch is too narrow to permit the permanent incisors to erupt in normal positions, then, although malocclusion of the teeth is not actually present, abnormal development is taking place.

Malocclusion is characterized by: (a) the abnormal position of one or more teeth; (b) abnormal arch form; (c) abnormal mesiodistal relationship of the arches. Frequently, two or three of the above mentioned characteristics may be present in a single case.

Orthodontic treatment may be divided into three phases: (1) preventive treatment; (2) corrective treatment; (3) posttreatment.

1. *Preventive Treatment.*—This includes measures applied in cases in which malocclusion has not yet occurred or in which some abnormality exists but efforts are being made to prevent additional malocclusion. An illustration of this feature of treatment is the extraction of a deciduous tooth at the proper time or the placing of a space-maintaining appliance after the premature loss of a deciduous tooth.

2. *Corrective Treatment.*—This may be considered as including: (a) the breaking of habits that are factors in causing malocclusion; (b) muscular exercises to correct abnormal development and function; (c) the use of mechanical devices known as orthodontic appliances.

3. *Posttreatment.* — This phase which will not be discussed in this paper, includes muscular exercises and the use of mechanical devices known as retaining appliances, designed to maintain the conditions obtained by corrective treatment.

For the purpose of simplifying the study of this subject, I have divided the time of rapid growth and development into periods as follows: Period A, birth to 3 years of age; Period B, 3 to 6 years of age; Period C, 6 to 8 years of age; Period D, 9 to 11 years of age; Period E, 12 years of age. The ages mentioned are merely averages, and the individual variation should always be considered after a careful study of full mouth radiograms. I shall endeavor to outline what, in my opinion, is the logical treatment at different periods of development of the individual.

Period A. Age: birth to 3 years. During this period all of the deciduous teeth should erupt.

The treatment is nutritional and pre-

ventive. The patient should be provided with the proper food to produce normal general development, which will naturally include the requisites for a normal development of the jaws and teeth.

The posture of the child should be such that no pressure is permitted, while the child is awake or asleep, to interfere with normal development of the jaws. The use of a pacifier or sucking the thumb or fingers should not be permitted. Care should be taken to prevent the child from practicing lip, tongue or cheek habits, which may be important causative factors in malocclusion. The child should not be permitted to imitate a person with deformed face, such as an individual having a prognathous mandible.

The advice of a capable rhinologist should be followed as to the removal of infected tonsils or hypertrophied adenoid tissue, for these may also be etiologic factors.

Full mouth radiograms should be used as a diagnostic aid in every instance. Sometimes, when a radiogram shows that a permanent tooth is missing, it is advisable to extract the corresponding deciduous tooth to permit the mesial movement of the teeth posterior to such area. The radiograms also provide information as to the amount of absorption of deciduous roots; as to the amount of development of permanent teeth; as to whether or not teeth are developing in normal form and position, and, occasionally, as to the presence of supernumerary teeth or other anomalies.

Period B. Age: 3 to 6 years. During this period, all deciduous teeth should be present.

When a child reaches the age of three years, it is usually possible to gain his confidence and institute corrective orthodontic treatment, if necessary, with reasonable expectation of good results.

If the patient has acquired injurious habits that are causing abnormal development, these should be corrected as soon as possible. In no case is orthodontic treatment with appliances advisable while such a habit is being practiced. It is better to postpone the use of orthodontic appliances until such habits are entirely broken than to depend on the habit being discontinued during treatment. The secret persistence in these habits is frequently the cause of relapse of a case. Orthodontic appliances are sometimes indicated to prevent sucking of the thumb or fingers.

The age of 3 to 4½ years is a particularly favorable period for corrective orthodontic treatment. It is so both because the individual is in an early period of development and because, at this time, the roots of the deciduous teeth have attained their full development, and absorption has not commenced. Thus, the maximum benefit in influencing the growth of the jaws and the positions of the developing permanent teeth may result from their movement.

Orthodontic treatment during this period is not indicated if the abnormality consists only of one or more teeth in slight malocclusion, provided the form and mesiodistal relationship of the arches are normal. If one or both arches are not normal in form or if there is an abnormal mesiodistal relationship of the arches, treatment should be applied.

At the age of 5 to 6 years, the anterior sections of both dental arches

should normally be growing in width to accommodate the larger permanent incisors, and spaces should appear between the deciduous incisors and cuspids. If this growth does not occur, both arches should be widened to provide the necessary space.

Period C. Age: 6 to 8 years. During this period, the permanent first molars and incisors should erupt.

At this time, correction of malocclusion of the incisor teeth is indicated, as soon as possible after their eruption. It should be remembered that, frequently, the lower incisors, particularly the lower lateral incisors, begin to erupt somewhat to the lingual of the dental arch, but are assisted into their normal positions by the pressure of the tongue.

If the upper central incisors are widely separated after eruption, it is advisable to move these teeth into their normal positions and maintain this relation until after the upper lateral incisors erupt and assume their positions in the arch. The correction of abnormal arch form is also indicated, and usually involves widening of the dental arch or arches. This is a particularly favorable time to widen the arches, because of the length of the roots of the deciduous molars and cuspids and the small amount of development of their permanent successors. Correction of abnormal mesiodistal relationship of the arches may also be accomplished, but is not indicated if the deciduous incisors have roots that are practically all absorbed, or if they are loose or have been lost and the permanent incisors have not yet erupted.

The first three periods mentioned, which cover the growth of the patient from birth to and including the eighth year, are the most important years for orthodontic treatment to produce maximum beneficial results.

Many cases, the treatment of which may include correcting malocclusion of individual teeth, change of arch form and change of mesiodistal arch relationship at this time, will require no further treatment. In any event, the subsequent normal development of the teeth and jaws is encouraged if abnormal conditions are corrected during this time.

Period D. Age: 9 to 11 years. During this period, the bicuspids should erupt.

At this time, changes of individual tooth position are indicated, as well as the correction of abnormal mesiodistal arch relationship, but widening the arches by moving the deciduous molars and cuspids bucally is not always successful because of the considerable absorption of the roots of these teeth and a corresponding lack of influence on the developing permanent teeth. A decision as to the advisability of treatment should be made in this, as in all cases, only after a careful study of recent radiograms.

The bicuspids erupt during this period, and corrective treatment should be applied to these teeth as soon as they appear in abnormal positions. It is much easier to assist teeth into normal positions as they erupt than to move them later. This is especially true when considering bicuspids, on account of their long cusps.

If a deciduous molar is lost prematurely, an effort should be made to maintain the proper space, which is the width of the tooth that was lost, until its successor is ready to erupt.

As soon as a bicuspid tooth erupts, the corresponding deciduous molar in

the opposite jaw on the same side of the mouth should be removed, for we cannot expect a harmonious development of the dental arches if this rule is not followed.

Period E. Age: 12 years. During this period, the second molars and cuspids should erupt.

Occasionally, second molars erupt in malocclusion, and, in these cases, it is advisable to begin treatment as soon as it is possible to apply properly directed force, before they are well established in fully developed investing tissues.

The cuspids also normally erupt at this time, although, in many cases, the lower cuspids erupt much earlier. As a preventive measure, plenty of space should be provided for these teeth. The lower cuspids usually erupt in normal positions if the arch is of normal size. The upper cuspids occasionally fail to erupt properly, and, in some cases, are found to be in perversion, or lying in an abnormal plane. If it seems impossible for an upper cuspid to erupt without surgical or mechanical assistance, treatment should be applied promptly, without waiting years while the alveolar process continues to develop and thereby makes treatment more difficult. In practically every case of this type, an attempt should be made to move the tooth into a normal position rather than to extract it and supply an artificial substitute.

Orthodontic treatment is indicated, in any case of malocclusion, only after a careful diagnosis, a thorough study of the case history and etiology and the elimination of as many of the causative factors as possible. Do not lose sight of the fact that although a casual observer may note that the crowns of teeth are being moved by mechanical appliances, the really important feature of orthodontic treatment is the development of bone to support the teeth in normal positions, so that there may be functional perfection, which is of vital interest when considering the health of the patient.

Too much emphasis cannot be placed on the fact that, even with a thorough knowledge of the etiologic factors, a correct diagnosis and proper orthodontic treatment, the end-result will not be entirely satisfactory unless there is complete and hearty cooperation on the part of the patient.

DISCUSSION

*R. C. Willett, Peoria, Illinois:* In the essay under discussion, Dr. Baker deals with a subject which became of vital interest to me in the very beginning of my practice in orthodontia, and interest has developed through the study and observation of many cases coming under my care. I am pleased to note that Dr. Baker has not undertaken to cover the whole field of indications for the treatment of malocclusion, but has forcefully dwelt on the desirability of early treatment during the period of the child's rapid growth and development. The essay stresses certain fundamentals of a normal progression, and the causes and effects of malocclusion, a knowledge of which is essential to the general practitioner of dentistry, as well as to the orthodontist. In many cases, the primary causes of malocclusion do not come within the scope of the orthodontists' ordinary practice. They are present at a very early age, and, because of this, it follows that only through the education of those who are responsible for the child's physical welfare during the early stages of primary dentition can the most effective measures for the prevention of malocclusion be carried out. The purely technical knowledge of the orthodontist must be supplemented and governed by a finely balanced judgment in detecting, and differentiating between, the many etiologic factors of malocclusion occurring at an earlier age than that in which normal spaces should appear between the deciduous teeth. Because of the variation of normality in different

individuals, it is a question in my mind whether we should expect, in every case, to see spaces developing between the teeth even as late as at 5 years of age. The problem is one that involves the many vital processes of functional activities affecting and governing the phenomena of dentition, as well as those remoter effects of heredity that must be taken into account for the making of a complete diagnosis. Individual characteristics must always guide the final decision as to whether or not orthodontic treatment is indicated in the case of a child who is approaching the time of eruption of the first permanent molars, and the loss of the mandibular deciduous incisors. In these cases I have made it a practice to take modeling compound impressions which show distinctly the formation of the palate, and from which accurate measurements could be taken with a millimeter gage, for the purpose of determining whether or not the arch measured 28 mm. in width between the cervical margins of the second deciduous molars on the lingual. If the arch is less than 28 mm., the fact assures us that there will not be sufficient development to accommodate permanent dentition and that we are warranted in applying mechanical stimulation, regardless of the fact that no permanent tooth has made its appearance. Bogue originated this measurement as an index. I have filed many casts, made in cases in which patients, brought to me for consultation, were referred to me a few years later for further consultation or orthodontic treatment. These enduring records fully confirm the observations made and reported by Bogue; for in no case in which the cast recorded a deficiency in width of the dental arches have I found, at the time of the second examination, any increase of width in the bicuspid region. I am convinced that the period prior to the eruption of the first permanent molars is the most satisfactory time in which to take advantage of these indications for orthodontic treatment. I have yet to find one case of a healthy growing child in which mechanical stimulation applied to either arch failed to secure the desired expansion of the arch, at the same time carrying with it the first permanent molars, which later erupted in correct alinement. Another advantage in following out this early indication for orthodontic treatment is that, in most cases, if the inclined planes of the deciduous teeth are not interfered with, the force applied to the teeth of the mandibular deciduous arch will, through the force of occlusion, bring about an expansion of the maxillary arch, and the most natural stimulation to bone growth be afforded. A word in regard to the space maintainer. Properly applied, it will fulfil a most important purpose in preserving the arch form, and the occlusal relation, and in preventing the impaction of bicuspids, which so frequently occurs through the premature loss of deciduous molars. After such a loss, it occasionally happens that the bicuspids erupt as early as at 7 years of age, and a rule from which there should be no departure is that the area in which a space maintainer is to be placed should be radiographed, in order that the position of the unerupted teeth can be determined. In considering the advisability of a space maintainer, not only should radiograms be made of the area, but also periodical checking up should follow as a means of determining just when the space maintainer should be removed. In the construction of a space maintainer, it is of the utmost importance that the teeth of the opposing arch have an occlusal contact with the connecting bar, that function shall be restored, as well as space maintained for the unerupted bicuspid. Dr. Baker suggests postponement of the use of orthodontic appliances until habits are entirely broken. I question the advisability of following this suggestion, unless as a precaution taken to guard our reputations against an occasional failure in the treatment of these cases. My conviction, in regard to habits, is that we should seek the cooperation of those having the care of the child, and, with a fair and frank explanation of the handicap, begin the treatment. While some patients persist in the practice of habits affecting occlusion, many will be broken of such habits much earlier through our close cooperation and aid. The important issue is to correct the malocclusion during the period of rapid growth and development, when the results obtained through the orthodontic treatment are so much more satisfactory and permanent; an opportunity which would be lost, in many cases, if we delayed treatment until the pernicious habit was entirely broken.

*Max E. Ernst, St. Paul, Minnesota:* Most of the statements here made can be accepted as those of orthodontists in general at the present time and in the light of present

knowledge. The subject of malocclusion has too long been viewed by the dental profession from its mechanical aspect. The development of the dental arches is subject to the same biologic laws and principles as the development of any other part or organ of the body. That being the case, we must view this subject as of a biologic nature and approach it from that standpoint. Normal growth is largely dependent on normal form and normal function. Form and function are so definitely correlated that any abnormal condition in one will be manifested in the other. Normal occlusion of the teeth and normal development of the jaws are the result of the interaction of many factors, all of which are functioning in a normal manner. A deviation from the normal in any of these factors persisted in for any length of time will be a contributing cause in producing malocclusion. As a rule, the orthodontist sees his patients only after they have been referred to him for treatment by the physician or dentist. The dentist, in order that he may properly inform his patients regarding malocclusion, its prevention or treatment, not only should have a fair knowledge of the factors generally accepted as causative of malocclusion, but also should recognize the condition in its incipient stages, to the end that the child may receive the correct advice or treatment, and at the proper time. The dentist then must know what is normal for the child at different periods of growth, so that any deviation from the normal may be readily noticed at the earliest possible time. He should also recognize the fact that malocclusion is always a progressive process and that slight abnormalities frequently develop into extreme malformations and disfigurements. He should know that, in general, corrective measures should be instituted as soon as it is apparent that abnormal development is taking place. The theory that, in the past, was advocated by the dentist, namely, to wait until the permanent teeth had all erupted before beginning treatment, has been shown to be unsound. Such advice is equivalent to telling a patient to wait until the case has progressed into its worst possible state before interfering with corrective treatment. While our efforts should always tend to produce a development of the jaws and dental arches that will be normal for the individual at his particular age or period of growth, our ultimate aim in the treatment of malocclusion is to produce a normal occlusion after all permanent teeth have erupted. If our early treatment, namely, treatment of deciduous or mixed dentitions, makes it possible for the permanent teeth to erupt normally into their proper positions, this treatment may be classed as preventive, and prevention today is the keynote in both medical and dental practice. Certainly, a large number of the cases being treated after 13 and 14 years of age would be far more satisfactory had they been treated preventively years before we attempt our corrective treatment on the permanent teeth. Dr. Baker says that to obtain and maintain a normal result, it is essential that "all tissues that are associated by location or have an influence through their function" be normal also. Abnormal development is largely the result of abnormal function. Any habit, therefore, that tends to bring abnormal stress on the jaws or the muscles attached thereto will be a factor in producing malposition of the teeth. It will then be readily seen that such habits as mouth breathing, and lip, tongue or other pressure and posture habits should be discontinued as soon as possible. This paper divides the age of the child into five periods, the first of these from birth to 3 years. During this period, it is fairly common to find no indications for orthodontic treatment. In other words, arch form and arch relationship are generally correct at this period. Malrelations of the jaws at birth have been reported, and malrelations of the dental arches are occasionally seen before 3 years of age. Dr. Baker states that treatment during this period is nutritional or preventive. Nutritional treatment involves proper food for growth and development. It has been brought to our attention that malocclusion is present in much larger percentage in the mouths of children who were artificially fed during infancy than in those who were normally fed. While no definite theories are advanced, we are led to believe that normal feeding during infancy may play an important rôle in the development of normal occlusion. It would seem that the muscular effort necessary to obtain food in the normal way must have some effect on the development of the parts to which these muscles are attached. After the teeth have erupted, the food should be such that they may be vigorously used. Use of the teeth brings into function the muscles of mastication, which,

in turn, stimulate the jaws to their proper development. Lack of use of the teeth means lack of muscular activity, which leads to a lack of development. In Period B, 3 to 6 years of age, in general, cases of malrelationship between the dental arches should be corrected as soon as the confidence of the child can be obtained. This is especially true in cases of mesioclusion, or Class 3. Cases of this type are not uncommon at this early age, and they may be treated very successfully in a short time. These cases progress into malformations and disfigurements probably more rapidly than any other types and should be corrected at the earliest possible time. Cases having a lack of so-called developmental or growth spaces between the anterior teeth in children of 5 or 5½ years are quite certain to show lack of development and malocclusion in the permanent dentition. The deciduous arch should be enlarged to the point where room is provided for the permanent teeth to erupt without interference or crowding. While in some cases it may be necessary to institute further treatment, when permanent teeth erupt to malposition of individual teeth, often no further treatment is necessary. Cases showing a lack of vertical development, with a deep overbite in the anterior region, are often found during this period. It is undoubtedly good practice to treat this condition at an early age, since the condition itself may seriously hinder the lower arch and jaw in its forward growth and may be responsible for a distal relationship of the lower to the upper arch later on. Period C, 6 to 8 years of age, includes the eruption of permanent first molars and permanent incisors. If there is a lack of development of the arches, the anterior teeth, or some of them, will be in malposition. Upper and lower lateral incisors generally assume a position of labioversion or linguoversion. It often happens that the lower lateral incisors erupt in linguoversion, and in these cases, the dentist, hoping to improve the condition, advises the removal of the deciduous cuspids to gain space for the incisors. The result of this treatment is that the lateral incisor assumes a fairly normal position, but, owing to a lack of room in the arch and a drifting of teeth, it will soon be found in contact with the deciduous molar, leaving no space for the permanent cuspid when that tooth is ready to erupt. The case, then, has developed into a much more serious and difficult one, owing largely, to the wrong advice given the patient earlier. As Dr. Baker says, we should aim to produce a development of the jaws and dental arches that will be normal at the particular period of growth. We can readily see that extracting teeth from an arch that is already deficient in development would not be the proper procedure. Our efforts should be to bring the arch to a state of development in which all teeth would be accommodated. This can readily be done during this period. The roots of the deciduous molars are still sufficiently long that force applied to these teeth is transmitted to the unerupted permanent teeth, with the result that these teeth, when they erupt, are likely to assume the position to which the deciduous molars were removed. Forward growth of the dental arch at this period depends largely on the proper contact of deciduous molars. A premature loss of a deciduous tooth during this period may, in itself, be a factor in producing malocclusion of permanent teeth, unless the space resulting from the loss is maintained until the successor is ready to erupt. In Period D, 9 to 11 years, undoubtedly a large percentage of cases are referred to the orthodontist for treatment. Cases of malrelationship of the arches should be corrected at once. Cases involving mainly an enlargement of the dental arches, in certain instances at least, may be postponed until the bicuspids make their appearance. On account of the fact that the roots of the deciduous molars are largely absorbed at this time, the moving of these teeth will have little or no effect on the bicuspids that succeed them. In such a case, it may be proper to wait until the bicuspids erupt before undertaking treatment. Often, I find it advisable, in these cases, to advise the removal of the deciduous molars in order that the bicuspids may erupt earlier and treatment may be instituted without any great delay. If there is radiographic evidence of the rotated unerupted bicuspids, which so often obtains, it may be proper to wait until these teeth erupt before undertaking treatment, since it will be necessary to correct the rotation after the teeth erupt, and malposition of other teeth may be corrected at the same time. If in any cases during this period there is not sufficient room in the arch to accommodate the unerupted permanent teeth, space should be provided as soon as possible so that the eruption be not interfered with. Dr. Baker

says that it is much easier to assist the teeth into normal position as they erupt than to move them later. I should like to add that if teeth are moved into position before being fully developed and the roots are allowed to develop in the new position, the prospects of their being so maintained are much more favorable than when they are moved after being fully developed. Dr. Baker has long advocated the removal of a deciduous molar if the opposing bicuspid has erupted. If you will consider the difference in the mesiodistal dimension as well as the difference in the occlusal contour of the deciduous tooth and the bicuspid, you will readily see that this advice is sound. In Period E, 12 years, all permanent teeth except the third molars are generally in position. Any malposition of teeth or malrelation of arches should be corrected at once. A tooth whose normal eruption has been retarded on account of lack of room should have space provided for it rather than to wait until it has erupted into malposition and then attempt to correct the condition. At this age, postponement of treatment brings the patient beyond the period of rapid growth and the prognosis becomes less favorable. In these cases, as well as practically all others, the well known slogan "Do it now" should apply. In most cases of malocclusion, evidence of the condition was present at a much earlier age than we may have supposed. The dentist, then, should so inform himself that he may detect deviations from the normal occlusion at the earliest possible time, and he should realize that early treatment offers far greater possibilities of obtaining a normal condition than is the case when treatment is postponed to a later age.

*Samuel Herder, New York, N. Y.:* In the treatment of an abnormal frenum of the upper lip which appears to have caused the separation of the upper central incisors, it was stated that the condition could be treated by the simple procedure of bringing the central incisors to approximal contact by means of an orthodontic appliance, without surgically removing the frenum with either lancet or cautery. I have had two patients recently with widely separated upper central incisors, showing an actively movable and abnormal frenum between them. It appears to me that this abnormal frenum is the direct cause of the separation of the central incisors. Is it not therefore true that the removal of the cause, namely, the frenum, is necessary in order to retain the central incisors in their corrected position? When I told my patients that it was necessary to have the frenum removed by means of a lancet, they refused to have it done, even though I told them that I would use an anesthetic. I could be of service to these patients if I could treat them by means of an ordinary orthodontic appliance instead of the use of a lancet or cautery.

*Dr. Baker (closing):* Dr. Willett has made an honest criticism of my statement regarding the application of orthodontic appliances only after all injurious habits have been broken. I appreciate his desire for prompt treatment, a principle which is generally recognized as correct. But having had many cases relapse into malocclusion owing to the fact that certain habits had not been broken, I seldom depart from the rule as stated in my paper. There may be times when good judgment will indicate the use of orthodontic appliances before the practice of these habits is entirely discontinued, if you can get the earnest cooperation of the patient, but as this paper is intended as a message to the general practitioner, I wish to emphasize, as strongly as possible, the importance of certain habits as causative factors in malocclusion. As regards corrective orthodontic treatment for patients who have only deciduous teeth: I have treated quite a number of these cases and the results were very satisfactory. Of course, I do not advise the treatment of cases in which there is slight malocclusion of one or more teeth, but I believe that corrective treatment is positively indicated if there is abnormal arch form or abnormal relationship.

# MANDIBULAR MOVEMENTS AND OCCLUSION*

By JOHN W. NEEDLES, D.D.S., Kansas City, Missouri

THE past ten years or slightly more has seen many radical changes in dentistry. Recognition of the important rôle of focal infection in its relation to health has been one of the greatest factors in producing these changes. Innumerable teeth and many dental restorations have necessarily been sacrificed for the sake of better health. As a result, the dental profession has been compelled to devise new and more efficient means of replacement. This has been all the more imperative because many of the sufferers are still young. To avoid social and business handicaps, they have demanded the utmost in dental restorations. The dental profession has responded by continuous and intensive study. The work of all the pioneers in dental prosthesis has been reviewed and their findings have been carefully considered. The principles taught by Bonwill, Miller, Bennett, Christensen and Gysi, which had had but little attention, were at last getting a hearing. Dr. Rupert Hall and Dr. House were some of the most active men in stimulating an interest in careful prosthetic work. Later, Dr. Monson's articles setting forth his theory of spherical occlusion were published. These called still more attention to the problems of occlusion, and a very general interest was developed.

The annual meetings of the National Society of Denture Prosthetists which became the forum for the discussion of prosthetic problems, have been devoted almost exclusively to the study of the various conceptions of mandibular movements. The many ideas have been subjected to the most critical examination and, in spite of much confusion and partisanship, the fundamental facts have, in large measure, been agreed on, although there is still some dissenting opinions on minor points. This paper is not intended as an official report of the findings of that society. The presentation is purely on my own authority and gives only my own conception of the facts as I see them. I wish here to make a general acknowledgement to all who have aided in developing the ideas presented, although I will not, in many cases, make specific reference to the sources from which the information has been obtained.

Careful study of the anatomy of the mandibular joint reveals that it is a compound joint, one portion of which is designed for hinge motion and the other portion for a sliding motion. I feel that the only logical method of studying mandibular movements is to divide them into their two elementary components and to refer each movement to its respective portion of the

*Read before the Section on Full Denture Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

joint. I will consider then that the hinge movement takes place between the heads of the condyles and the fibrocartilage and that this constitutes a pure hinge joint. For this reason, in any articulator, the axis of the opening movement should be so placed as to correspond to the heads of the condyles. In addition to the anatomic reason just given for this conclusion, there are also clinical and experimental grounds for

Fig. 1.—Appliance for making tracings of mandibular movements in position on patient.

it. Dr. Snow designed the face bow for the purpose of placing casts in an articulator in their correct relation to the hinge joint. If this practice is followed, clinical experience shows that the articulator may be opened or closed a considerable distance without producing any error in the occlusion of dentures or prosthetic appliances under construction. Further evidence of the same kind is to be seen in the use of interdental splints in fracture cases. In constructing these splints, the cast of the lower is sawed through at the site of the fracture and reassembled in corrected position by means of its occlusion with the upper. The casts are then positioned on the articulator with a face bow. The articulator is then opened a sufficient distance to allow the patient to be fed through the opening. This necessitates an opening between the teeth of approximately one-half inch. I have used this method of treatment in quite a number of fracture cases and have never found a case in which the occlusion was not satisfactory on removal of the splint. This would not

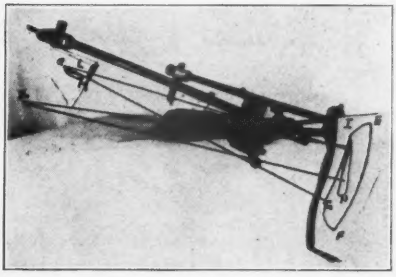

Fig. 2.—Upper portion of same appliance, showing tracings.

be the result if it were incorrect to consider the condyle chord as the opening axis.

Experimental evidence can also be obtained by use of the face bow or similar appliance. If the face bow is held in fixed relation to the mandible by means of an impression or otherwise and the indicators are placed over the condyles, these will remain stationary while the patient opens the mandible slightly. In patients with a protrusive bite, the mandible may even be opened widely without movement of the condyle indicators, for the reason that such patients do not protrude the mandible in order to approximate the anterior

teeth. In other patients, the condyles will come forward as the mouth is opened widely. If these patients are shown how to retrude the mandible while holding the mouth open, the mandible may then be closed without movement of the condyle indicators.

To further study this point, impressions were taken of patients with natural teeth both above and below. An appliance was then made that would fit accurately about the teeth of each jaw and could be held quite rigidly in position. A frame was attached to the upper to carry cards in the condyle region and in the median line in front of the symphysis. Another frame was attached to the lower, carrying pencils over the condyles and near the symphysis, by means of which tracings of the opening movement and straight protrusion were taken. The appliance attached to the upper teeth carries a horizontal plate across the palate. The lower carries a bar from one side to the other, in the center of which is a small ball. When the mandible is closed, the ball rests against the plate in the palate in such a manner that the mandible may be protruded without interference from the cusps of the teeth or the overbite. Figure 1 shows the apparatus in position; Figure 2, the upper portion of the apparatus carrying the tracings. I have lettered the incisal tracing *I, E, F, G* and *H*, and the condyle tracing *C, L, M*.

The portion of the tracing from *I* to *E* represents straight protrusion without opening. It is the pure protrusive element. The corresponding portion of the condyle path is *CL*.

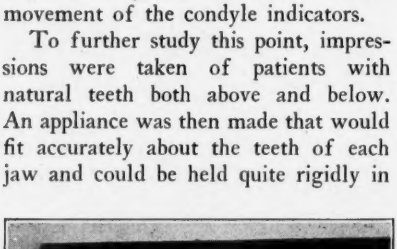

Fig. 3.—Horizontal view of upper portion of appliance which carries record cards.

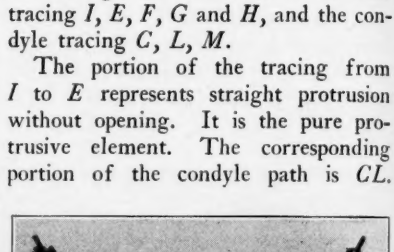

Fig. 4.—Horizontal view of lower portion of appliance carrying pencils.

The path from *E* to *F* represents a pure opening component in a protrusive position. The path from *F* to *G* is retrusion plus a slight closing. From *G* to *I* is a pure closing component. The two arcs *EF* and *GI* have their centers at the respective positions of the condyle at *C* and at *L*. The loop from *I* to *H* and back is produced by the habitual opening and closing movement. This path is variable in form and position as the patient does not trace the same path in successive trials. It is apparent that this latter movement contains both opening and protrusive elements. It is from such a tracing that

Dr. Gysi reached the conclusion that the opening axis was behind and below the condyles at some point, such as *X*.

In the condyle path *C-L* represents protrusion. *L* to *M* is produced at the same time *E* to *F* is produced. It represents an additional protrusion plus a deviation due to the fact that the condyle head does not have an even curvature. The path from *M* to *C* corresponds to path *FGI*. These considerations seem sufficient to demonstrate that the opening axis of an articulator should be placed in the condyle chord.

The sliding or protrusive element anatomically takes place between the fibrocartilage and the articulator surface of the temporal bone. When both sides slide forward simultaneously, straight protrusion is produced. When one side is stationary and the other side moves forward, the mandible moves to one side as in the working bite. Varying degrees of movement on the sides produce all the intermediate positions. When the anterior portion of the mandible is supported by the ball and plane appliance described above, protrusive lateral and intermediate movements of the mandible are more or less accurately spherical in nature. Experience over a number of years in the use of spherical bite rims demonstrates to me that the movement never deviates more than slightly from the surface of the sphere, evidence of which is seen in the fact that it is difficult to find cases in which these surfaces do not remain in balanced contact throughout all the movements of the mandible. The radius of this sphere is approximately 4 inches, as described by Dr. Monson. Recently, it has been quite gratifying to me to see that some modification of the spherical bite technic is being quite widely adopted. The men who are using this method state that they are getting much better results than by other methods, which seems to me another evidence of the correctness of the spherical principle. The technics advocated by Dr. Monson and his group, by Dr. McCollum, Dr. Wadsworth and me, all make use of the spherical principle in some form, and every other technic that involves an adjustable condyle path conforms in principle, although their sponsors may not admit it.

### THE ROTATION AXIS

In Dr. Gysi's investigations, he used a method of taking tracings on a transverse plane that was practically parallel to the condyle paths, and a tracing of the incisal path in a horizontal plane. A study of these tracings led him to the conclusion that the condyle on the working side is not a still point but that, at this point of least, motion is somewhat internal to the condyle. This point he designated as the rotation center. Further study also developed the fact that this point was frequently posterior to the condyle line. Whenever we speak of an object, such as a wheel, rotating, we refer the movement to an axis, not to a point. An axis is a line which is perpendicular to the plane of rotation. When we apply this idea to Dr. Gysi's rotation center, we find that his center is only one point on an axis of rotation and that there are many other points that lie on this same axis. Soon after reading Dr. Monson's article on spherical occlusion, in May, 1920, it occurred to me that the center of the sphere as described by Dr. Monson was another point on this axis of rotation. The axis, then, is a line passing through Gysi's rotation center and inclined inward and forward so that it intersects

the sagittal plane. There is a rotation point on each side, and the two axes arising from them may intersect the sagittal plane at the some point. When this occurs, all the postulates of Dr. Monson's theory are true. We know that frequently the condyle paths on the two sides do not have the same slope. In this case, the rotation axis of the two sides will not meet at a common point in the sagittal plane, but each side must be considered separately. The spherical theory, while not meeting all the physical conditions of practical cases, does offer the best mental picture of ideal conditions. It is apparent from the foregoing that the conceptions of Dr. Gysi and Dr. Monson are not antagonistic but that each of them expresses only a part of the truth.

Dr. Gysi has shown the importance of the rotation axes in determining the paths of the cusps, but in practice it is not necessary to determine the actual position of these axes. Their position is found from tracings of one or more points on the occlusion. But after we have taken these tracings, it is simpler to adjust an incisal guide that will reproduce the form of these tracings than it is to attempt to find the actual location of the rotation axes, and the results are the same. The method of spherical bite technic that I developed in the summer of 1920 offers a means of recording the paths of three or more points on the occlusal surface. The records taken determine definitely central occlusion and also afford a means for adjusting both the incisal path and the condyle paths, so that all the data necessary for the adjustment of any articulator are obtained in the one operation.

The three point tracing as used in this technic also affords a ready means of checking up the accuracy of an articulator. Following one tracing only is no test of the value of an articulator, but an instrument which can be shown to follow three simultaneous tracings is accurate. Let us now turn from mandibular movements to a study of the occlusion of the teeth themselves. The intermeshing of the teeth of the two jaws in proper relation to each other is quite generally understood. What is meant by balanced occlusion has also been frequently defined. The difficulty we have is in knowing how to attain this balanced relation. The first essential is that the casts be mounted in correct relation to the opening axis. The second essential is that the condyle paths be accurately adjusted. The form of the incisal path must also be known. With these conditions assured, it is only necessary to arrange the teeth with the proper curvature and inward inclination to secure a balance. A few trials will quickly show what positions the teeth must have to attain the best results.

In denture construction, the area of the denture base is a factor of first importance. There is a definite limit of pressure that the tissue of the mouth can tolerate on each unit of area. If the denture base is large, it will distribute the load over a greater area of mucous membrane, and as a result, a greater total force can be applied than when the denture base is small. The force necessary to masticate food depends on the area of tooth contact. It is apparent, then, how illogical it is to use teeth with broad surfaces in a denture resting on a narrow alveolar ridge. In natural teeth, before wear has taken place, we find that the area of actual cusp contact is very small; in fact, mere

points. The fissures and grooves are deep and the ways of escape for food are ample. The cusps are convex and the marginal ridges are sharp. In chewing, the cusps move across each other in such a manner that they produce only a line contact. Wear of the teeth rapidly increases the area of contact and necessitates greater force and more lateral movement in mastication.

This should teach us that, in artificial teeth, we should keep the total occlusal area small as compared to the denture base; that the teeth should be formed with deep sulci, sharp marginal ridges and ample embrasure spaces, and that the minimum amount of grinding should be done. The area of a surface increases not in proportion to its diameter but as the square of its diameter. If teeth are ground so as to make the contact surface two to three times as great in diameter, we have increased the resistance from four to nine times.

We can readily see from this how inefficient are many dentures with excessively ground occlusal surfaces.

In studying the occlusion of natural teeth showing little wear, it is observed that, when the cusps are interlocked, there is still a slight movement possible. Most people will observe that when their own teeth are placed in central occlusion, they are still capable of movement to a small degree in any direction without interference. This condition Dr. House has described as freedom of occlusion. When this condition does not prevail, he describes it as a locked occlusion.

In the examination of a large number of artificial dentures, either as they are first completed or after they are ground on the articulator, or ground with abrasive in the mouth, as is commonly done, it has been found that a locked occlusion is the unvarying rule. To correct this condition Dr. House developed a form of grinder which he calls the rotary occlusal grinder. This device imparts to artificial dentures a degree of freedom very similar to that found in natural dentures.

The occlusal surface of the teeth is very little changed by this form of grinding. The actual condition produced can be described as similar to a mortar and pestle. Each of the cusps is ground so that it is slightly smaller than the fossa into which it is received, this resulting in a slight freedom of movement in all directions. Patients whose dentures have been ground to this freedom of movement always remark on the greater comfort which they experience. The irritation and soreness of the gums is greatly reduced, and it is confidently expected that further observation will demonstrate a marked decrease in the progressive absorption of the alveolar ridges.

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# MODERN DIAGNOSTIC METHODS, WITH SPECIAL REFERENCE TO PULP CONSERVATION*

By ALFRED WALKER, D.D.S., F.A.C.D., New York City

IT is entirely superfluous to refer here to the researches extending over the past fifteen years on the pathogenic possibilities of pulpless teeth, except to point the important moral that little has been done in that same period of a practical nature toward the conservation of the dental pulp. This statement may come as a surprise to those who hear it. But I challenge any one to point to constructive practical effort leading toward protection of the dental pulp, except the work of Hyatt[1] in advocating prophylactic odontotomy, and that of the Bödeckers,[2] Pollia,[3] Raper[4] and others in advocating a roentgen-ray survey of approximal tooth surfaces. Much effort has been expended in the field of the treatment of teeth whose pulps have been lost, and great advances have been made in that branch of dental practice. But as regards conserving the vitality of pulps not yet lifeless, or hopelessly involved by disease, we can only point to investigation whose very laudable effort has been directed toward the total prevention of caries. This, of course, represents an ideal well worth striving for, and one which bears hope of ultimate accomplishment.

In the meantime, we must deal with present-day conditions; in other words, with teeth that cannot be entirely protected against the initiation of caries. Teeth presenting caries and other disease conditions are seen in every-day practice, and the object of this paper is to show that these conditions can be controlled by the application of modern diagnostic methods. It seems unnecessary to review the histology of the pulp; but it will be necessary to refer to some theories, advanced many years ago and still accepted, and based, in part, on histologic evidence, which have, through all these years, influenced practice with reference to this organ.

These theories revolve around the concept of the extreme delicacy of the pulp and its extreme susceptibility to unfavorable extraneous influences. I refer first to the still popular belief that the pulp may lose its vitality as the result of thermal shock. I do not mean to

*Read before the Section on Operative Dentistry at the Seventh International Dental Congress at Philadelphia, Pa., Aug. 24, 1926.

1. Hyatt, T. P.: Dent. Cosmos, 65: 234 (March) 1923.

2. Bödecker, H. W. C. and C. F.: Diagnosis of Hidden Caries by Means of the Radiograph, Dent. Rev., 26: 378 (April) 1912.

3. Pollia, J. A.: J. Dent. Res., 5 (April) 1922.

4. Raper, H. R.: Items Int., 47: 906 (Dec.) 1925.

imply that the condition of the pulp is not influenced by thermal shock, but I dispute the claim that extremes of temperature alone will result in pulp death. This belief, a sort of superstition handed down from the past, is probably founded on experiences in which deep fillings have been placed without complete removal of decay. We know that, under such circumstances, death of the pulp is inevitable, owing to bacterial invasion; but this theory of thermal shock probably antedates the acceptance of the germ theory of disease, and we now recognize the fact that sensitiveness to temperature changes is a symptom of pulpitis, not its cause. But before this fact was appreciated, it was only natural that these symptoms, followed by pulp death as they were, should give rise to that belief.

While the profession still holds to the idea that thermal shock is a cause of pulp death, another belief, which was held for a long time, has finally been discarded. This is the idea that exposed pulps can be kept vital and healthy by pulp capping. This practice has been discarded because of its universal failure. We perhaps have not realized fully why capping of exposed pulps cannot succeed.

The difficulty lies not so much in the irritation to the pulp of a foreign material in contact with it as in the fact that pulps exposed by caries are hopelessly infected and diseased before the operation is performed. On the other hand, in pulps exposed by operation instead of by caries, when due regard is given to asepsis, pulp capping frequently gives satisfactory results.

Fig. 1.—The occlusal surfaces of the lower teeth, in a man, aged 32, plainly showing carious areas on the four bicuspids and the left first and second molars, the second molar showing a silicate filling with carious areas extending mesially and distally from the filling. No staining or retouching was resorted to.

Another fallacy regarding the supposed delicacy an dsusceptibility of the dental pulp has recently been brought out in the researches on teeth having incomplete pulp canal fillings. In many of these cases, remnants of the pulp have been found to retain their vitality over a long period of years. My thought here is not to advocate such operations as I have mentioned, but to point out that

the dental pulp is a tissue endowed with much greater resistance than has formerly been attributed to it.

On the other hand, it has been found unwise to depend too much on pulp resistance. In other words, the practice of leaving an uncertain amount of partially or completely decayed dentin over a pulp, and attempting to sterilize this diseased dentin, has not always given satisfactory results. While such researches of Gies,[5] Howe,[6] Bödecker and others, which have proved conclusively that the pulp continues to provide a circulation extending throughout the dentin and even extending into the enamel. That such circulation is of benefit to the hard tissues of the tooth can hardly be questioned. I mention this simply by way of confirming the premise of this paper, that one of the most important duties of the dentist is

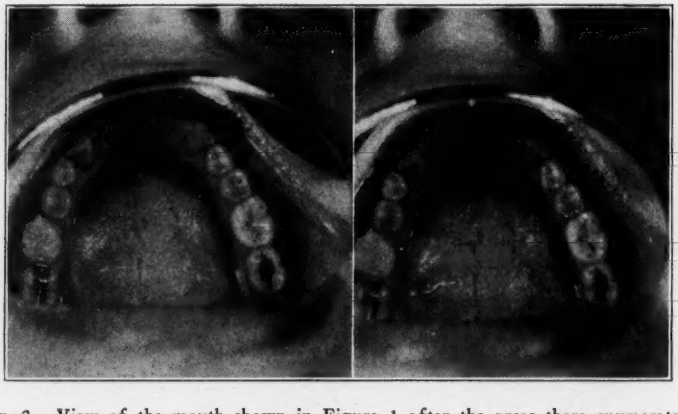


Fig. 2.—View of the mouth shown in Figure 1 after the areas there enumerated were cut into with a No. 1 bur, the cutting being extended just beyond the dento-enamel line. The silicate filling was removed from the second molar. The débris was removed from all cavities and, without staining, the teeth were photographed. The carious areas are still plainly visible in all of the cavities, showing that, in each instance, the dentin was more or less extensively involved, and on none of these surfaces would the finest explorers catch.

cedures have in them an element of value, their chief usefulness is rather in the direction of retarding the involvement of the pulp than preventing it.

It may be well, at this point, to refer to another, older theory regarding the dental pulp, which has been widely accepted in the past. It was that the pulp, being a formative organ for the dentin, had no function after the completion of the tooth development. This theory has been completely dissipated by the the preservation of the dental pulp, and while the review of these theories may prove that the dental pulp is not the susceptible tissues we once imagined it to be, common sense will indicate clearly the folly of putting its resist-

5. Gies, W. J.: Studies of Internal Secretions in Their Relation to the Development and Condition of the Teeth, J.A.D.A., 5: 529 (May) 1918.

6. Howe, P. R.: Report on Finding of Lead in Tooth Enamel. (Unpublished.)

ance to the test as frequently as is being done in modern dental practice.

Keeping in mind the fact that it is not possible, at the present day, to prevent dental caries, and keeping in mind the fact that the only practical means of preserving the dental pulp lies in the earliest possible discovery of caries, we come now to a study of modern dental practice from this point of view.

Fig. 3.—Inferior right first molar, with bicuspids and second molar, showing where the mesial-occlusal surface has been cut away in the course of cavity preparation involving that area. The film does not indicate involvement of the distal surface of the second bicuspid. However, a definite area was plainly visible to the eye.

It should be unnecessary to defend the dogma that all carious areas should be excavated and filled as soon as discovered. But even when these areas are discovered, it is the practice of many dentists not to fill these cavities, on the assumption that when they are very small, filling is unnecessary and may properly be deferred. The fallacy of this practice has been shown by careful investigation of many such cases. Extensive study of such cases has proved to my satisfaction that the extent of carious involvement cannot be determined until excavation has been performed. It has invariably been found that, in these cases, carious involvement has been much more extensive than examination has indicated. It remains only to say, on this point, that immediate filling should be performed wher-

Fig. 5.—Apparently slight areas on the distal surface of the inferior right first molar and the mesial surface of the second molar. All carious matter was removed, but no further preparation attempted. The cavities were filled with guttapercha and radiographed.

Fig. 4.—Bicuspids and molars. The carious area on the distal surface of the second bicuspid was removed with a bur (no further cutting was done), and the cavity was filled with guttapercha and radiographed. The result shows that, although the carious area penetrated the enamel deeply it was not disclosed by the roentgen ray.

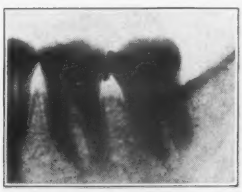


Fig. 6.—Deep penetration of caries disclosed in Figure 5.

ever and whenever carious areas are discovered. This rule admits of no exceptions. If we adopt this principle, our next thought should be for the earliest possible recognition of caries, and it is in this branch that our profession has lagged so lamentably in late years.

Fig. 7.—Caries under the filling (gold inlay). In this case, there was a marked discoloration around the margin of the filling, plainly visible to the eye, but no pain or other symptoms.

Think of it. We still use the ordinary mouth mirror and explorer, which twenty years ago constituted the dentist's only equipment for making an examination. Few indeed even supplement these with drying of the tooth surface, or the use of the magnifying lens. But even when we utilize such aids to vision, we still neglect an agency whose place cannot be taken by any other diagnostic aid. I refer to the radiogram, which reveals so much that we cannot see by ordinary vision, no matter how amplified.

Fig. 8.—Extent of the carious area as indicated by the filling.

This phase of the subject was first brought to the attention of the profession by H. W. C. and C. F. Bödecker in 1911, and has more recently been emphasized by Pollia and Raper.

Prior to the writings of these men on this procedure, dentists frequently noticed evidences of caries in radiograms taken for other purposes. But until they emphasized this aspect of the radiogram, few appreciated its significance, and fewer still have made it a routine part of the examination for caries. Recently, Raper has brought more forcibly to the attention of the profession his technic for roentgen-ray examination for approximal caries. Let no one think that Raper's presentation is merely the fad of a roentgen-ray enthusiast, and that it is unnecessary in

Fig. 9.—Caries under a filling (gold inlay), but with no marginal discoloration or other visible indications. In this instance, the patient suffered pain, which, at times, was extremely severe, but could not be localized. It is seen that the caries involves the pulp. The roentgen ray also discloses an area above the cervical margin of the inlay. Figures 1-9 are all taken from routine cases and are typical rather than exceptional. Many similar examples might be shown.

modern practice. My own experience, which I shall proceed to detail for you, has proved conclusively that the mouth examination is incomplete without the approximal roentgen-ray survey.

My experience in this phase of mouth examination brought my first surprise at the number of cavities revealed by the roentgen-ray which I could not detect by the explorer or the coloration of the tooth. My next surprise was at the depth of the cavities so revealed. I invariably found, on excavation, as I shall demonstrate to you on the screen, that caries actually had penetrated considerably farther than was indicated by the radiographic shadow.

This was indeed a stunning discovery. I have often opened into cavities which, if judged by the roentgen-ray, would seem to have involved only the enamel or to have extended but slightly beyond, only to find that the dentin had been deeply penetrated. An interesting experiment, and one I have frequently performed, consists in excavating these cavities showing apparent caries, and then examining them again by roentgen-ray after inserting guttapercha in the excavated, but not prepared, cavity. The comparison of the two radiograms furnishes a striking corroboration of the statements I have just made. Furthermore, I have yet to meet a case in which the roentgen ray showed a perceptible shadow, wherein the dentin was not involved in some degree.

On the other hand, the roentgen ray will not disclose those areas that have only slightly involved the enamel without penetrating to the dentin. This procedure has an important bearing on cases of proposed orthodontic treatment. I wish to repeat here a statement that I made in discussing a paper on "The Necessity for Revising the Cavity Preparation for the Cast Gold Inlay" by John J. Travers, D.D.S., in May, 1925, that, in every case in which orthodontic bands are to be placed, a preliminary roentgen-ray survey for approximal caries should be made. The result of neglect of this simple precaution may be most serious. Failure to observe this precaution may, and frequently does, result in pulp involvement before caries is discovered. The orthodontist, if not the general practitioner, should insist on its observation for his own protection.

It will be well, at this point, to recapitulate briefly the means of assuring the early discovery of caries and, through this, providing a practical and effective protection for the pulp. Surfaces which are visible to the eye, directly or by reflection, may be examined by this means. They must in the first place be dried thoroughly. This implies the use of compressed air, following the washing of the surface with alcohol. Magnification is essential, as, by this means, areas that are negative to the finest explorers may be discovered to be carious. The explorer is, of course, valuable. It must be properly designed as to shape and slenderness, and a sharp point must be maintained on it at all times. By these means, carious areas may be detected on surfaces not so well delineated by the roentgen-ray. But examination of the approximal surfaces, except where the surfaces are plainly visible, can only be properly and completely made by the aid of the roentgen-ray.

The accompanying illustrations do

not represent exceptional cases. Many such cases could be shown, since they represent instances of caries discovered in routine examinations.

The methods of examination just described are not the total of available diagnostic tests. They may, of course, be supplemented by transillumination and other tests. They are presented as representing an irreducible minimum in the examination routine.

CONCLUSION

Caries cannot be disclosed by explorers alone.

Caries may not be disclosed by the roentgen ray.

Approximal caries involving the enamel alone may not be disclosed by the roentgen ray.

Approximal caries as disclosed by the roentgen ray has, in most instances, penetrated deeply into the dentin.

# DENTAL TECHNIC METALS*

By NORRIS O. TAYLOR, Iowa City, Iowa

TECHNIC metals, if we may apply this term to the metals which the dentist uses in his laboratory other than those which he actually uses as filling materials, cover wide ranges of chemical composition. The development of these alloys has been largely by cut and try methods rather than by systematic study. As a result, we find many alloys recommended for the various laboratory uses, their description being a more or less accurate statement of composition together with the name of the man who first suggested its use. This has given us literally hundreds of named alloys which, together with the "trade-named" alloys manufactured at present, serve more to confuse the layman than to be of service to him, since many alloys similar in properties are known by different names.

In considering the technic metals, we may group them into two general classes: 1. Those used as dies and counterdies, including those known as fusible alloys. 2. Substitute filling materials for use in laboratory for practice work and demonstrations.

The accepted physical properties of die and counterdie materials are as follows: For dies (1) the metal should (*a*) cast easily at temperatures sufficiently low to prevent the decomposition of plaster molds, (*b*) fill the mold completely, giving an accurate copy of all the details of the mold, and (*c*) have little contraction following solidification; and (2) the solid casting should be hard enough to resist any force applied during the swaging operation and should not change shape during the process.

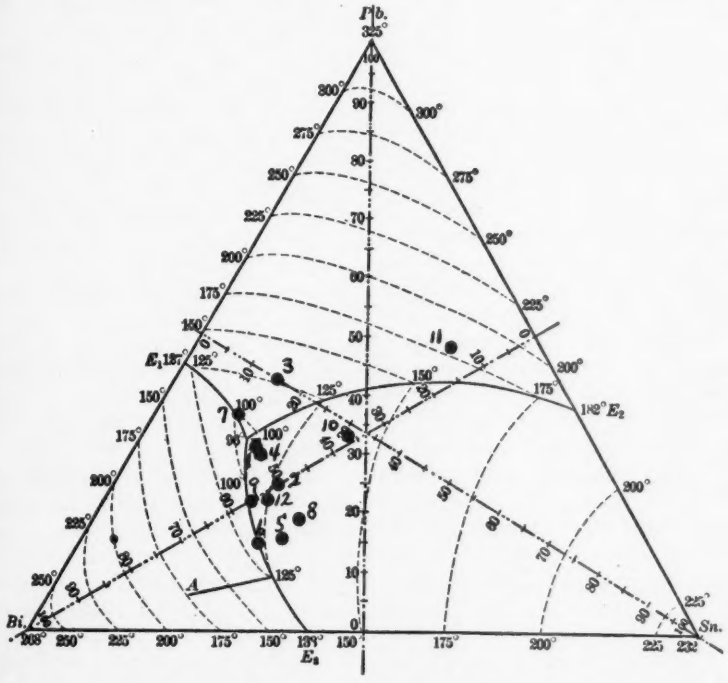
For counterdies, the materials used should (*a*) cast at temperatures lower than the melting point of the die so that it may be cast directly upon it, and

*From the Chemistry Department, State University of Iowa.

*Read before the Section on Physics, Chemistry and Metallurgy at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

(*b*) be softer than the die, but hard enough to force the material being swaged into exact contact with the die.

The metals commonly used for these purposes include zinc, tin, antimony, copper, lead, bismuth and cadmium and their alloys, each with the others. Babbitt, the general term designating a variety of antimony, copper and tin alloys, lead base alloys, including the lead-antimony and lead-antimony-tin alloys and the low melting alloys of bismuth-lead and tin and of bismuth-lead-tin and cadmium, are among the




Fusion diagram of the System lead-bismuth-tin. (Charpy); taken from Ruer-Mathewson's "Elements of Metallograph." The numbers and compositions indicated refer to alloys listed in Table 1. The triangular diagram is used to designate the proportions of the three elements used to make up the ternary alloy series. In an equilateral triangle, the sum of the three lines drawn from any point within the triangle perpendicularly to the three sides is equal to the altitude of the triangle. If the altitude of the triangle is taken to equal 100 per cent of the alloy, we find that the distances of any point perpendicularly to the sides will represent, by their lengths relative to the altitude, the percentage of each constituent in the alloy. Thus, the point marked (8) will be found to have a composition of 50 per cent Bi, 31.25 per cent Sn and 18.75 per cent Pb. It is customary to represent compositions on a base of this sort and to plot the values of the physical properties perpendicularly to this base, developing a three-dimension figure. The isotherms shown in the diagram may be considered as contour lines indicating the slope of the upper surfaces of such a figure, showing the upper limit of fusion of the ternary alloys of bismuth, lead and tin.

commonest types of alloys used as die materials.

The metals used are proportioned so that the resulting alloy has a set of hard crystalline particles to receive and resist the stresses applied in swaging. These are imbedded in a matrix of a softer metal or alloy, which allows slight readjustments of the hard particles but acts as a cementing material and prevents the deformation of the material under stress or its rupture from the sudden shocks of swaging. In the babbitts, the hard particles are chemical compounds of copper and tin and of antimony and tin imbedded in tin. The hard particles in the antimony-lead alloys are crystals of antimony and in the antimony-tin-lead alloys, SbSn, a chemical compound and crystals of antimony in lead. In the various fusible alloys, the hard crystals are eutectic, or low melting, mixtures of the elements in the alloy imbedded in a matrix of either lead or tin, which is present in excess of the amount necessary to form the low melting mixture.

The babbitts generally used in dental work are approximately 80 per cent tin, 10 per cent copper, 10 per cent antimony, although the tin content may vary from 66 per cent to 90 per cent, the antimony, from 4 to 25 per cent, and the copper, from 4 to 15 per cent. The lead-tin and antimony-tin-lead alloys are usually classed as solders and type metals and contain, as a rule, at least 50 per cent lead, the tin and antimony varying over wide ranges.

Perhaps the most interesting alloys from the dental point of view are the fusible or low melting alloys of bismuth-lead-tin and of bismuth-lead-tin and cadmium. Many of these alloys have been developed for dental uses and named after their sponsors. In considering the binary alloy series that go to make up the bismuth-tin-lead series, we find that bismuth and lead form a low melting mixture containing approximately 54 per cent bismuth, fusing at 127 C. Bismuth and tin form a similar mixture, melting at 133 C., and containing about 58 per cent bismuth, and a mixture of 67 per cent tin with lead fuses at 182 C.

Charpy[1] has given us the results of a complete investigation of the ternary series, and these are summarized in the accompanying diagram.

This diagram shows us that the eutectic mixtures of the binary systems combine further to give us a ternary eutectic which melts at 96 per cent C., its composition being approximately 52 per cent bismuth, 11 per cent tin and 32 per cent lead. The isothermal lines on the diagram pass through compositions which begins to fuse at the temperatures indicated.

In this ternary series, we find many of the alloys that have been used by dentists for many years. The compositions of several of these alloys are given in Table 1 and are indicated by number in the accompanying diagram.

TABLE 1.—FUSIBLE ALLOYS OF BISMUTH, TIN AND LEAD.

| | Composition by Weight* | | |
|---|---|---|---|
| | Bi Per Cent | Sn Per Cent | Pb Per Cent |
| 1. Newton's | 50.00 | 18.75 | 31.25 |
| 2. Rose No. 1 | 50.00 | 25.00 | 25.00 |
| 3. Rose No. 2 | 42.11 | 15.78 | 42.11 |
| 4. Onion's | 50.00 | 20.00 | 30.00 |
| 5. Darcet's No. 1 | 53.85 | 30.78 | 15.38 |
| 6. Darcet's No. 2 | 59.26 | 25.82 | 14.81 |

1. Ruer-Mathewson: Elements of Metallography.

| | Bi Per Cent | Sn Per Cent | Pb Per Cent |
|---|---|---|---|
| 7. Darcet's No. 3 | 50.00 | 12.50 | 37.50 |
| 8. Mellot's | 50.00 | 31.25 | 18.75 |
| 9. Cliche's | 55.60 | 22.20 | 22.20 |
| 10. Brophy's | 36.40 | 30.30 | 33.30 |
| 11. Fusible | 12.90 | 38.70 | 48.40 |
| 12. Bi solder | 53.10 | 24.80 | 22.10 |

*Hodgen's Dental Metallurgy, Hepburn's Dental Metallurgy and Mark's Handbook.

In noting the location of these alloys on the diagram, we find that, with the exceptions of Nos. 3, 7 and 11, the compositions are such as to give crystals of the eutectic with some excess tin, the fusing points varying from 100 to 140 C. The other three alloys have an excess of lead, No. 3 melting at approximately 128 C., No. 7 at 100 and No. 11 at 180 C.

By studying the diagram and the compositions of the various alloys, it becomes evident that we can generalize to some extent on their properties although, in general, the physical properties of the alloys are very similar. The hardness values and tensile strengths increase gradually as we approach the eutectic composition. The closer we can approach the ternary eutectic, the lower the melting point of the alloys. Alloys containing an excess of bismuth over that required for the eutectic would be too brittle to be of practical use. This is evidenced by the fact that the men who endeavored to develop and use these alloys found no satisfactory ones in that section of the diagram.

We have duplicated many of the alloys with either excess lead or tin in our laboratory and find little difference in the physical properties aside from the fusion point, provided we do not deviate much from the eutectic composition. At present, the students in our dental metallurgy laboratory make considerable quantities of Mellot's metal as one of their laboratory experiments. Every effort is made to turn out an alloy free from oxids and to eliminate waste. The metal produced is sold to the advanced students in our dental college, as well as to the college, at prices much below the price of similar alloys at the supply houses. The price of the product

TABLE 2.—FUSIBLE ALLOYS OF BISMUTH, TIN, LEAD AND CADMIUM

| | Composition by Weight* | | | |
|---|---|---|---|---|
| | Bismuth Per cent | Tin Per cent | Lead Per cent | Cadmium Per cent |
| 1. Woods'† | 42.84 | 14.28 | 28.56 | 14.28 |
| 2. Woods'† | 38.46 | 15.38 | 30.71 | 15.38 |
| 3. Woods'† | 48.40 | 12.90 | 25.80 | 12.90 |
| 4. La Nation | 45.00 | 24.53 | 17.90 | 12.27 |
| 5. Molyneaux | 41.64 | 16.66 | 28.00 | 16.66 |
| 6. Lipowitz | 50.00 | 13.33 | 26.67 | 10.00 |
| 7. Lichtenberg's | 24.20 | 44.70 | 24.20 | 6.90 |
| 8. Crouse's | 42.20 | 26.25 | 26.25 | 5.30 |
| 9. Fusible (?) | 52.20 | 7.00 | 26.00 | 14.80 |
| 10. Fusible (?) | 50.00 | 9.40 | 34.40 | 6.20 |

*Hodgen's Dental Metallurgy; Hepburn's Dental Metallurgy, and Mark's Handbook.
†Three of the seven compositions found listed as Wood's metal.

is largely dependent on the current price of bismuth, but, for normal price ranges, we find that we can produce this alloy to retail to the students at from 10 to 12½ cents per ounce. Other departments of the university have found use for the alloy, and we produce from 50 to 100 pounds of the material each year.

The addition of cadmium to the ternary alloys of bismuth, tin and lead tends to form a quaternary eutectic that melts at a still lower point than the ternary eutectic. The alloys of this type show fusion ranges varying from 56 to 100 C. and contain from 6 to 15 per cent of cadmium. The composition of several alloys of this type are given in Table 2.

A few cadmium-bismuth-lead alloys have been used, but, in the main, the quarternary alloys are the most commonly used. The addition of small amounts of mercury to any of these alloys will lower the melting point, 45 C. being about the lowest fusion point that can be obtained with an alloy solid at room temperature. (Darcet's, bismuth 15 per cent; tin, 7 per cent, lead, 7 per cent and mercury, 71 per cent.)

Alloys that are to be used as practice filling materials should duplicate fairly well the casting and working properties of the alloys that they are to replace and should have the advantage of being comparatively cheap. In the case of the amalgam alloys, we find that the high tin alloys on the market are reasonable enough in price and satisfactory in working qualities for laboratory work, and, in this case, we may consider that we are not working with a substitute, although the best information that we have on amalgam alloys points to the fact that alloys with high tin content are not satisfactory materials for building permanent fillings.[2]

The high cost of gold alloys makes a substitute material almost a necessity for practice work. Several trade-named alloys are recommended for inlay technic work in the laboratory, but, on comparison, the physical properties were found so different that analyses were made to determine the variations in composition. The analyses of the various alloys are given in Table 3.

TABLE 3.—COMPOSITION OF INLAY TECHNIC METALS.

| | Composition by Weight. | | |
|---|---|---|---|
| Alloy | Copper Per cent | Silver Per cent | Gold Per cent |
| A | 13.7 | 82.2 | 4.1 |
| B | 65.5 | 34.4 | 0.13 |
| C | 12.6 | 86.8 | (Ni, 0.6) |
| D | 4.9 | 68.7 | (Sn, 26.4) |

It was very evident that these alloys varied greatly from the composition of 50 per cent copper, 50 per cent silver, suggested by R. H. Volland, one of the early workers in this field.[3] The variations undoubtedly served to better some particular property at the expense of others, making the newer products better adapted for special uses than all around work.

Several of our better students were given the assignment of analyzing these alloys and of preparing duplicate materials as a part of their metallurgy laboratory work. The results obtained

2. U. S. Bureau of Standards Technical Paper 157.

3. Dr. Volland suggested, and for a good many years used, an alloy of 50 per cent Cu and 50 per cent Ag as a practice filling material. He required that the fused mixture be held fluid under cover from four to five hours to insure the best possible properties.

showed that the alloys of high silver content were the easiest to handle without oxidation and were more readily soldered owing to the absence of heavy oxid films. Alloys of this type did not have the color of gold and, while the working properties were similar, could not be used in demonstrations in which the color was important. The high copper alloys were more difficult to solder, owing to oxidation, but duplicated the color of gold rather closely after burnishing. Their working properties seemed satisfactory.

Silver-copper alloys, ranging from 85 to 15 per cent of silver, were also tested. These alloys were free from gold and gave results apparently as good as those containing small amounts of gold. In the commercial alloys, the gold present in very small amounts may have been present as an impurity. The larger amounts of gold seemed to have little effect on the working properties of the alloy but would probably increase the resistance to atmospheric corrosion.

These alloys are of little importance to the individual dental practitioner, but the dental colleges use considerable quantities of them. We believe that we can furnish alloys of this type for our dental college, making it as a metallurgy laboratory experiment under careful supervision, at prices from one-quarter to one-third the prices asked on the market.

From the studies that we have made of the metals used in the laboratories of the dental colleges, the following facts seem evident.

1. The alloys used by dental colleges, other than the actual filling materials, can be easily prepared.

2. The cost of these materials in the dental supply market is out of proportion to the actual value of the metals in the alloys, and while the prices might be considered reasonable for small amounts of material, they are excessively high when large amounts are purchased.

3. The services of the students in the dental metallurgy course can be and should be utilized to advantage in the preparation of many of the alloys at from one-fourth to one-half the market price of the materials.

4. A separate course in dental manufactures, similar to the courses in organic manufactures[4] now given in several universities, is a feasible project and could be operated in connection with metallurgy departments to effect very appreciable savings for the colleges concerned.

4. Summer courses in organic manufactures are given at several universities. The students enrolled make many organic chemicals under supervision at comparatively low cost. They receive university credit and are paid at rates varying from 25 to 40 cents an hour for the time spent in the laboratory.

# THE CIRCULATION OF LYMPH IN DENTIN AND ENAMEL*

By E. W. FISH, M.D., Ch.B., L.D.S., London, England

THE experiments here described were undertaken in order to ascertain whether the dentin and enamel of a typical mammal (the dog) are irrigated by the body fluids, and, if so, to what extent and in what manner.

## THE CIRCULATION OF LYMPH ALONG THE DENTINAL TUBULES, AND THE MARGINAL LYMPH PLEXUS

The subject of the circulation of lymph along the dentinal tubules and the marginal lymph plexus has recently been dealt with elsewhere,[1] but it will be convenient to recapitulate here, since several points have been elaborated by further investigation.

As a result of the experiments about to be described, it was found that there is, during life, a stream of lymph along the tubules of the dentin. This stream is of sufficient volume to carry with it solid particles of finely divided matter. India ink consists of such particles, in a state of suspension and when it is introduced into the living pulp, these minute fragments of solid pigment are carried up the tubules as far as the middle third of the dentin within an hour after their introduction into the pulp. The lymph stream occupies a space between the dentinal fibril and the wall of the tubule.

The experimental demonstration of this phenomenon is carried out as follows:

India ink is gently instilled into the pulp of a live dog and left there for an hour. A large young dog is selected in order to secure a large pulp chamber and so, relatively, minimize the disturbance of introducing the hypodermic needle into it. The dog is anesthetized and an intravenous injection of chloralose is given. Part of the crown of a canine tooth is then sawed off to expose the pulp and a fine hypodermic needle is passed gently down between the pulp and the dentin to a point about half way along the root. A syringe containing Reeves' waterproof India ink is attached to the needle, and as the needle is withdrawn, a trace of ink is allowed to flow without pressure into the space occupied by the needle. If pressure be used, the pulp will be dislodged, and the lymph circulation will be interfered with.

The ink may be left in either for one hour, to show the rapidity with which the particles

*Aided by grant from the dental board.

*From the Department of Biochemistry and Physiology, University College, London.

*Read before the Section on Anatomy, Physiology, Materia Medica and Therapeutics at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

1. Fish, E. W.: "Circulation of Lymph in the Dentinal Tubules, with Some Observations on the Metabolism of the Dentin," Proc. Roy. Soc. Med., 19 (Sect. Odont.): 59-72, 1926.

are carried along the tubules, or for twenty-four hours, to obtain a specimen showing somewhat deeper penetration of the ink and, at the same time, to allow the particles to enter a larger number of the tubules. In the latter case, chloroform is used without chloralose and a trace of arsenic may be placed on the exposed end of the pulp. Cement is then allowed to flow over the cut surface of the tooth to close the pulp chamber. After the time selected has elapsed, whether it be one hour or twenty-four, the dog is killed, and the teeth that have been operated on are extracted, decalcified, sectioned and mounted in balsam.

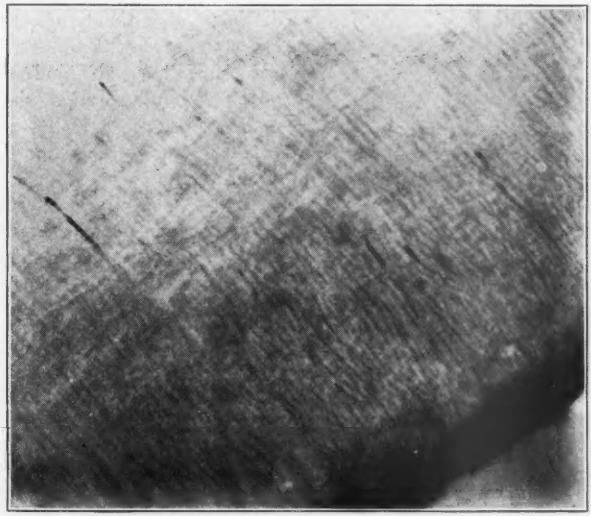


Fig. 1.—Photomicrograph of sections of tooth of dog. India ink was placed in the pulp for one hour before the dog was killed. (Compare Figures 2 and 3.) A large collection of ink pigment is seen in the subdental lymph space and has been carried a considerable distance up some of the tubules. (2/3 inch obj.)

It will be found, on examining sections of these teeth, that some of the ink has been washed away from the site of its introduction and has infiltrated between the odontoblast layer and the dentin into what we may call the subdentinal lymph space, and that, while many of the tubules in the region of the injection have become blocked by the larger particles of pigment, further along, where only the smaller particles have infiltrated the subdentinal lymph space and there is less disturbance of the pulp, these small fragments of the pigment have been washed up the tubules and appear along their course, in some cases as far as the middle third of the dentin.

In transverse section, these tubules appear as rings of ink surrounding the clear fibril, which occupies the center of the tubule and is free from ink. Occasionally, a larger amount of ink is found to have displaced the fibril to one side of the tubule.

When the ink has been left in the tooth for twenty-four hours before the

dog was killed, it appears in a greater number of the tubules and can be traced well into the outer half of the dentin. Accompanying it will be found a large amount of diffused blood pigment—the cause of the familiar darkening of a human tooth when hemorrhage has occurred in its pulp. This blood

Fig. 2.—Higher magnification of area shown in Figure 1, showing particles of ink pigment in the tubules.

pigment may be clearly demonstrated by immersing the section in acidulated potassium ferrocyanid solution, which turns the iron constituent of the hemoglobin blue. The blood pigment will, in this way, be shown to have penetrated the whole of the dentin.

It will be realized that it was necessary to introduce a fluid suspension of solid particles into the pulp in order to demonstrate an actual stream of lymph along the tubules, since a mere solution of dye might diffuse along the fibril and so appear in the tubules without being carried there by a definite flow of body fluids. When we find solid fragments of matter being carried along the tubules, we may postulate the existence of a true lymph circulation in them, and can form some conception of its volume.

In order to work out the ultimate destination of the lymph stream when its existence had thus been proved, it was legitimate, and indeed necessary, to use a simple solution, since the solid matter blocks the tubules and prevents further penetration. For this purpose, either methylene blue or a solution of ferrous ammonium citrate may be used. The iron solution, which has the advantage that the teeth may be subsequently decalcified, is introduced into the living pulp in the same way as the ink and becomes mixed with the lymph stream. The solution is left in the pulp for a period of time varying from ten minutes to one hour before the dog is killed. The teeth are then extracted, fixed, decalcified and cut, and the sections are immersed in potassium ferrocyanid and hydrochloric acid solution to turn the iron greenish blue. The iron, by its color, thus serves to indicate the distribution of the lymph circulation.

When a tooth has been extracted within a few minutes of introducing the iron solution into the pulp, the iron in the tubules is confined to the lymph space around the fibril. If the tooth is left for an hour before the dog is killed, the dentin is completely saturated with iron solution which has been carried along the tubules by the lymph and has diffused into the matrix and the fibril.

A second method of following out

the lymph distribution in the dentin is to introduce solid methylene blue into the pulp during life. A dog is anesthetized and a hole is drilled into the cervical part of the crown to expose the pulp. Solid methylene blue is placed in the cavity and sealed in for twenty-four hours. The dog is then killed, and ground sections are prepared for microscopic examination and fixed in ammonium molybdate.

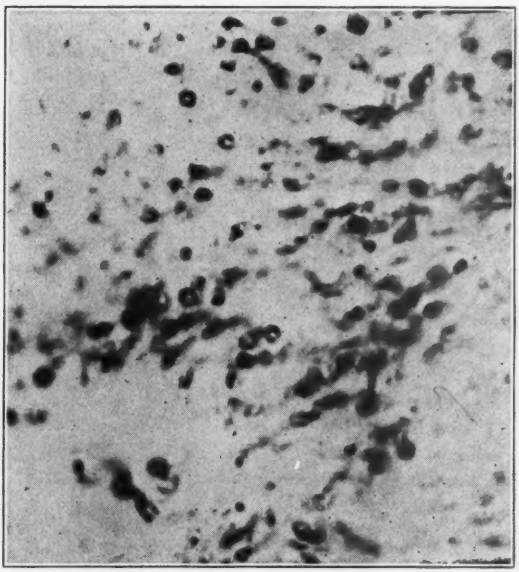


Fig. 3.—Tubules cut in transverse section showing location of ink in the lymph space round the fibril. The fibril itself and the matrix of the dentin are free from ink.

We may now consider what becomes of the lymph after it has passed up the tubules. It must either return to the pulp or else pass out of the tooth into the alveolar tissues. We find that it may do either. The lymph may either travel along a plexus which is formed by the terminal branches of the tubules to some other part of the dentin and return down the tubules of that part to the pulp, or it may pass out through the cementum to the lymphatics of the periodontal membrane.

In order to verify the accuracy of this conclusion, we must first examine the nature of the plexus formed by the terminal branches of the tubules. The details of this plexus are best seen in methylene blue sections prepared as just described. (Figs. 4-5.) The tubules are seen to divide into two equal branches, and these in turn break up into smaller branches, which anastomose freely and which contain the dyed lymph. These anastomoses, which are

extremely numerous, constitute the marginal lymph plexus.

We may now proceed to consider the function of this plexus of lymph tubules. It sometimes happens, in the methylene blue sections which are under consideration, that, in parts of the tooth, the dentinal tubules are free from dye, probably owing to injury at the time of operation whereby the circulation in them was obstructed. The plexus formed by their terminal branches is, however, seen to be full of the dyed lymph. It must follow from this observation that the lymph had passed along the plexus from some other part of the dentin where the circulation from the pulp up the tubules to the plexus was intact.

We have thus established a lateral movement of the lymph along the plexus. It remains to show that lymph can pass from the plexus back to the pulp. This will be seen to occur in experiments described later. Meanwhile, there are one or two other observations to make on the plexus itself.

In sections prepared from teeth in which iron has been introduced into the pulp, the plexus appears as a dark blue narrow band parallel with the periphery of the dentin and separated from it by a narrow zone which is relatively free from lymph. The darker color of the plexus indicates that a greater quantity of lymph is present in this part of the dentin than is present in the rest of the tissue, and supports the conclusion that this marginal lymph plexus is a true plexus or network of lymph channels permitting the distribution of lymph along it to other parts of the dentin. (Fig. 6.)

It would seem likely that the flow of lymph along the tubules is induced by the coordinated action of the Rouget cells on the walls of the vessels in the capillary network at the periphery of the pulp. These Rouget cells cause constriction or, alternatively, permit dilatation of the vessels, and are controlled by the autonomic nervous mechanism. In this way, by causing differences of pressure at the proximal ends of different groups of tubules, all of which are connected at their distal ends by the plexus of terminal branches, a flow of lymph along the tubules would occur.

Fig. 4.—Photomicrograph of tooth of dog. Methylene blue was placed in the pulp twenty-four hours before the dog was killed (red color filter used). (Compare Figures 5 and 6.) Longitudinal section of dentinal tubules showing bifurcation of the tubules and anastomosis of their branches forming the marginal lymph plexus. The general grayness of the area of the plexus is due to the large number of other branches just out of focus. (1/6 inch obj.)

It will appear that there is a lymphatic communication between the pulp and the alveolar tissues by way of the

dentinal tubules; hence, a proportion of the lymph from the marginal lymph plexus no doubt escapes to the lymphatic system of the periodontal membrane.

to trace out the lymph movements, shows that there is a narrow zone of dentin between the marginal lymph plexus and the cement or enamel, which

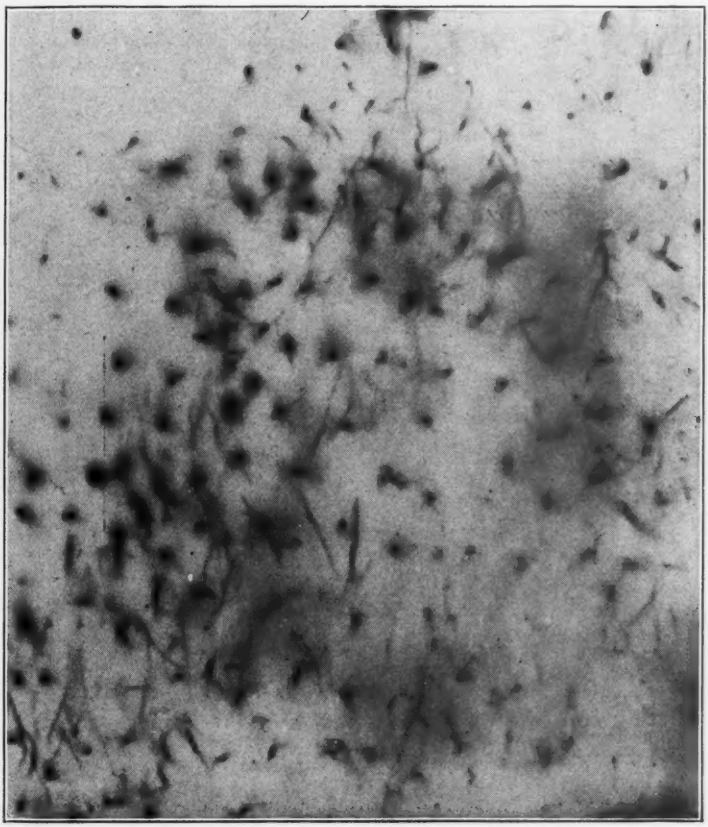


Fig. 5.—Transverse section of the tubules in the area of the plexus, showing anastomosing branches. (1/6 obj.)

### LYMPH PATH BETWEEN THE ALVEOLAR TISSUES AND THE PULP BY WAY OF THE DENTINAL TUBULES

An examination of the sections prepared as described, by introducing a solution of iron into the pulp in order

is relatively free from lymph and somewhat granular in appearance. This area no doubt corresponds to the granular layer of Tomes, but, despite its granular appearance, it will be noticed that it is traversed at fairly frequent

intervals by tubules from the plexus which terminate with an open end at the cement junction. (Fig. 6.) Not infrequently, these tubules bifurcate just at the cement junction, each branch remaining wide open, while, at times, two tubules from the plexus unite and form one channel, which terminates in an open end at the cement. Channels may also be seen in the cement which appear to communicate with the open ends of these tubules on one side and with the periodontal membrane on the other. These channels and tubules are filled with lymph containing the iron solution, placed in the pulp during life, and their presence suggested the probability of a direct lymphatic communication between the plexus and the periodontal tissues.

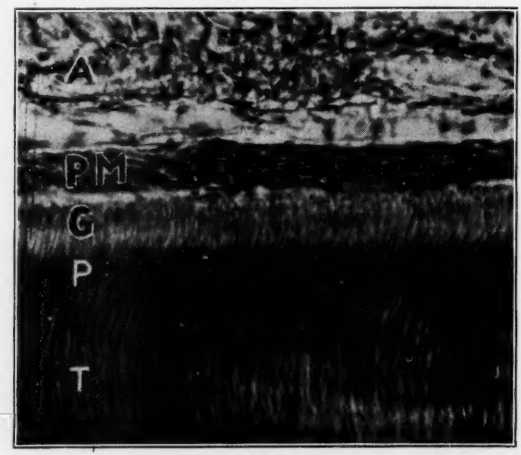



Fig. 6.—Photomicrograph of tooth of dog in situ. Ferrous ammonium citrate solution was introduced into the pulp one hour before the dog was killed. The sections were treated with potassium ferrocyanid (red color filter). (8 mm. obj.) *A*, alveolus; *PM*., periodontal membrane; *G*, granular layer of dentin between plexus and cementum crossed by tubules from plexus to cementum; *P*, marginal lymph plexus; *T*, tubules of dentin.

To investigate this further, the following experiment was devised:

A dog was anesthetized with chloroform and an injection of 1 minim or so of the ferrous ammonium citrate solution was made into the interdental gum papillae of the incisor region. Ten minutes later, the dog was killed, and the incisor region was rapidly excised, complete, with teeth, gum and jaw. This mass of tissue was at once placed in solution of formaldehyd (10 per cent dilution) to fix the tissues, and was then decalcified, and sections were made of the teeth and jaw in situ. The sections were treated with potassium ferrocyanid and mounted in balsam.

It was found, on examination of these sections (Fig. 7), that the iron solution had infiltrated the alveolar tissues at the site of injection and had entered the periodontal membrane. From here, it had crossed the cement in

places and appeared in the adjacent dentin. The marginal lymph plexus, at these points, was filled with the stained lymph, which was beginning to travel down the tubules.

The rest of the dentin, more remote from the site of invasion, was free from the iron solution. The iron had not had time to reach the apex of the tooth root so that it was impossible for it to have entered the dentin through the apical foramen and the pulp. Moreover, if it had done so, the iron would be seen advancing into the dentin from the pulp toward the periphery and not in the reverse direction, as is seen in these sections. (Fig. 7.)

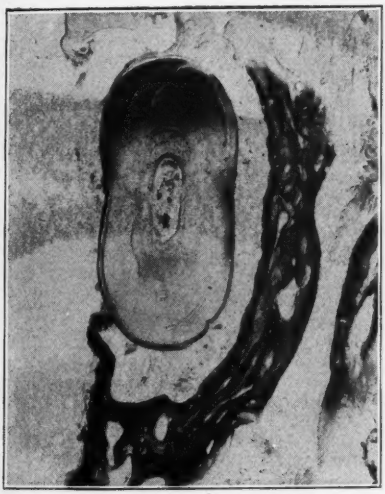


Fig. 7.—Photomicrograph of teeth of dog in situ. A minimum or two of ferrous ammonium citrate solution was injected into the interdental gum papillae ten minutes before the dog was killed. The sections were immersed in potassium ferrocyanid solution to turn the iron solution blue (red color screen used). (Compare Figures 8-9.) The iron solution has been diffused through the alveolus and has entered the periodontal membrane; from here it has been carried across in places into the dentin, and, at one point, has just reached the pulp. The iron solution appears black in the photograph. Two-thirds of the dentin is still free from the iron (planar short focus lens).

The pulp is found to be entirely free from iron in some of the specimens, while, in others, an advancing cone of iron solution from the periodontal membrane is seen just to touch the pulp with its tip. The experiment therefore shows that there is a direct lymphatic connection between the alveolus and the dentinal tubules across the periodontal membrane and the cement.

It has been possible to secure a transverse section through the tubules carrying the iron-stained lymph from the alveolus to the pulp and these show as blue rings with a clear center. (Fig. 9.) The dentinal matrix, as well as the fibril, is free from the blue tint since it has not had time to become infiltrated. This observation shows that the passage of lymph from alveolus to pulp along the tubules is a true circulation along the perifibrillar lymph space which the India ink was seen to traverse and also shows that the movement of lymph in this lymph space of the tubules takes place in either direction; that is, centrifugally or centripetally, according to the pressure equilibrium at the moment. In this way, the description given of the path of the lymph from the pulp up the tubules along the plexus and back to the pulp is completely demonstrated, and we have also now seen that part of the lymph may escape from the plexus to the alveolar tissues while

the lymph in the plexus is augmented by supplies from the periodontal tissue. If the dog is left for twenty minutes after injecting the iron solution into the gum papilla before it is killed, the whole of the dentin of the tooth will be found to contain iron. The occasional tubules crossing the zone between the cement and the plexus are deeply stained. (Fig. 8.) The plexus is a

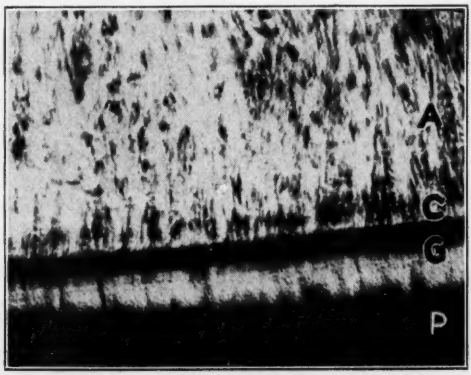



Fig. 8.—Higher magnification (area shown in Figure 7) of point at which the iron solution enters the dentin. The iron in the alveolus appears to be confined to definite channels, which are directed toward the periodontal membrane. The tubules crossing the granular area between the cement and the plexus are seen charged with iron solution. (In preparing this specimen, 20 minutes was allowed to elapse between making the injection and killing the dog.) *A*, alveolus; *C*, cement; *G*, granular layer of dentin between plexus and cement crossed by iron charged tubules; *P*, marginal lymph plexus heavily charged with iron solution. (8 mm. obj.)

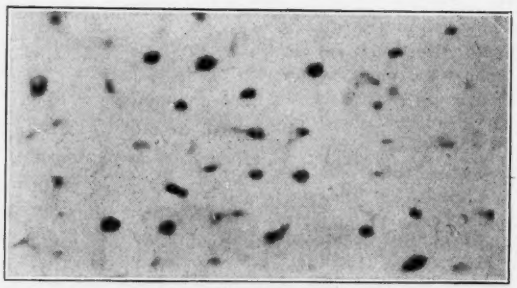


Fig. 9.—Transverse section of tubules carrying iron solution from alveolus to pulp. In several of the tubules, the iron solution appears as a dark circle surrounding the clear fibril. The matrix is free from iron. The iron solution is confined to the lymph space of the tubule. (1/6 inch obj.) (Compare Figure 3.)

very much deeper blue than the rest of the dentin, and, at the apex of the tooth, the lymph vessels leaving the pulp through the apical canals[1] are seen to contain the stained lymph. The concentration of iron in the lymph in these lymphatics is obviously greater near the pulp than at the alveolar end, which indicates that the iron is making its way from the pulp through these vessels and not entering it by these

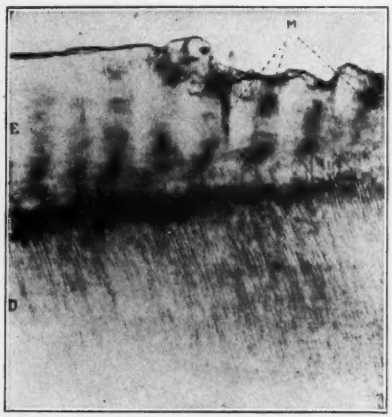



Fig. 10.—Photomicrograph of tooth of dog. Methylene blue was placed in the pulp twenty-four hours before the dog was killed (red color filter used). (Compare Figures 11-12.) Section of dentin and enamel showing the dyed lymph in the tubules, a large collection of lymph in the marginal plexus and lymph in the enamel. *E*, enamel; *M*, methylene blue in enamel; *P*, methylene blue in marginal lymph plexus; *D*, dentinal tubules containing the dye. (2/3 inch obj.)

channels. The lymph has thus been traced from the alveolus to the plexus, down the tubules to the pulp and thence back to the general lymphatic system of the alveolus.

## IRRIGATION OF THE ENAMEL WITH LYMPH

That the enamel has a supply of lymph was first observed by me in a young female dog that had been on a calcium-free diet for two months during pregnancy. She was apparently in perfect health, but is known to have lost calcium salts from the dentin dur-

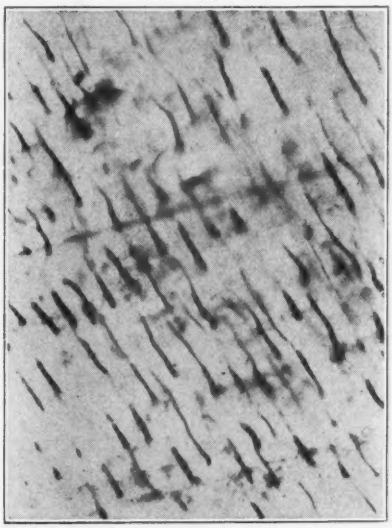


Fig. 11.—Methylene blue carried up the dentinal tubules and along an occasional lateral branch. (1/6 inch obj.)

ing the period of deficient diet. Whether this fact, which was the object of that particular experiment, had any bearing on the outcome or not, it was found that hemorrhages had occurred in the pulps of the front teeth. The shed blood had hemolyzed and the teeth were quite pink in consequence of the circulation of the hemoglobin solution in the dentinal tubules. Sections were ground of these teeth and

treated with potassium ferrocyanid to show the presence of blood pigment.

It was found that hemoglobin was present in both the dentin and the enamel. It had been carried almost to the surface of the enamel and was abundant in the part of the enamel covering the cervical half of the crown. It was absent from the enamel at the tip of the crown.

This observation seemed conclusive evidence of the irrigation of enamel by the body fluids, and it has been possible to confirm this conclusion in the following way:

Dogs were used for the experiments, both old and young animals giving the same results. The animal was in each case anesthetized and a hole drilled into the crown of several of the incisors and the canines, exposing the pulp. A trace of solid methylene blue was placed in the pulp chamber of each tooth and the cavities were sealed up with cement. The dog was kept under morphin until the following day and was then killed.

The enamel of the teeth which had been operated on was seen to be deeply stained by the dye, and it was observed that the neighboring teeth which had not been operated on were free from the dye; hence, it may not be inferred that the enamel had been stained from the outside by traces of methylene blue spilt at the time of operation. On grinding sections of these teeth, it was evident that the methylene blue had not entered the enamel from the outside, for the dye was found to have been carried from the pulp along the tubules to the marginal lymph plexus, where it appeared in considerable quantities. From the plexus, tubules were seen to be carrying dye to the amelodentinal junction, whence it passed along the periphery of the individual prisms almost to the surface of the enamel. The sections are fixed in ammonium molybdate and mounted in Farrant's medium. (Figs. 10-12.)

After the section has been kept for a few days, the dye is found to be fading and diffusing somewhat into Farrant's medium, and sections must therefore be freshly prepared for purposes of critical examination and photography.

Fig. 12.—Amelodentinal junction showing tubules coming from the marginal plexus to the enamel and methylene blue in the enamel prisms. The dark outlines of the prisms is due to the presence of the dye in the prism sheaths. (1/6 inch obj.) (Compare Figure 13.)

By grinding very thin sections of the enamel of some of these teeth in atypical planes, so as to cut across the prisms transversely, it has been possible to obtain definite information as to the precise track of the lymph in the enamel. The high magnifications of the enamel shown in Figures 13-15 were

photographed in ammonium molybdate solution immediately after the sections were ground and indicate clearly that the dye is confined in the most rigid manner possible to the prism sheath.

The prisms or rods themselves are utterly devoid of stain and probably, therefore, of lymph. Their cross striations are equally free, and hence the prisms may be regarded as relatively inorganic. The interprismatic substance in like manner is completely free and may be looked on as being of like nature. It would seem inevitable, however, that we regard the peripheral part of the prism, which is obviously carrying stained lymph with such clear cut definition, as being organic in nature. It must then be either a lymph space or an organic membrane. The former is unlikely, for two reasons: 1. It takes some hours for the lymph to reach this situation from the pulp; whereas, in the dentin, the circulation is so free along the tubules that twenty minutes has been found sufficient to irrigate the whole dentin completely with iron solution. If the prisms had a lymph space around them with a free circulation, the dye would appear in it with corresponding promptness. 2. The enamel would be a very fragile structure if it contained such numerous lymph spaces, completely surrounding the prisms.

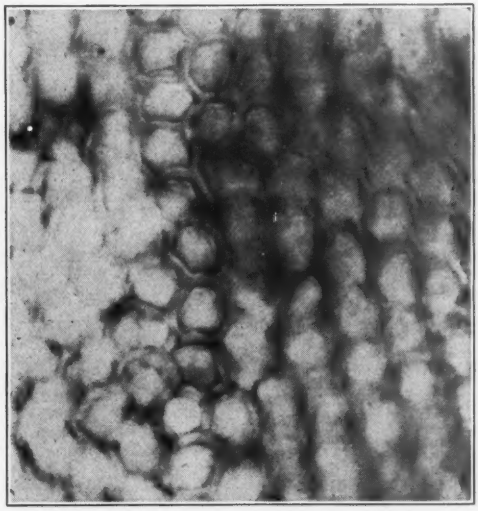


Fig. 13.—Photomicrograph of tooth of dog; transverse section of enamel prisms. Methylene blue had been placed in pulp twenty-four hours before the dog was killed (red color filter and 1/6 inch obj. used). (Compare Figures 14-15.)

The dye is carried by the lymph into the enamel and is seen to be rigidly confined to the prism sheath. The interprismatic substance and the prism itself are seen to be free from lymph.

The inevitable conclusion from these experiments would appear to be that the enamel prism has a cuticle or sheath of an organic nature which derives its nutrient supply from the lymph in the dentinal tubules.

The way in which the lymph enters the enamel would appear to be as follows:

In the dentin just below the enamel, the tubules are seen to end in a plexus in precisely the same way as in the root of the tooth. Tubules filled with dyed lymph are seen to leave the plexus and end just at the amelodentinal junction in small dilatations, which give off minute branches. If one of these branches is carefully followed, it will be seen to cross the amelodentinal junction and end at the rounded tip of an enamel prism, and the prism itself will then have a blue tint, owing to its cuticle's being irrigated with the dyed lymph from the tubule.

It is possible that this prism sheath is capable of becoming calcified in those parts of the enamel which are subjected to mechanical stress or irritation. The tip of the crown is found to be relatively free from lymph, as also is the actual surface layer of the enamel, although the lymph penetrates quite freely almost to the surface.

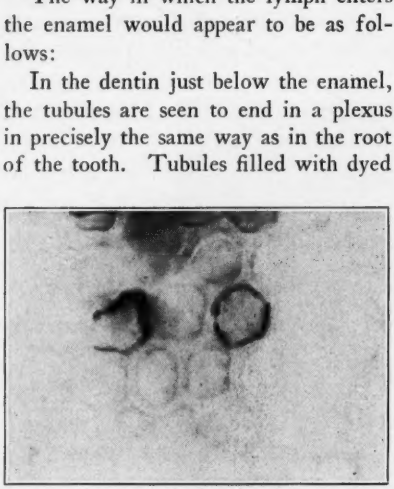


Fig. 14.—Photomicrograph of tooth of dog. (Compare Figures 13-15.)

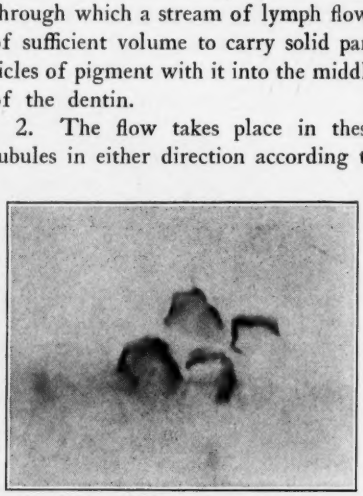


Fig. 15.—Photomicrograph of tooth of dog. (Compare Figures 13-14.)

## SUMMARY

1. It has been demonstrated that the dentinal tubules are lymph channels through which a stream of lymph flows of sufficient volume to carry solid particles of pigment with it into the middle of the dentin.

2. The flow takes place in these tubules in either direction according to the varying pressure in the surrounding tissues.

3. The terminal branches of the tubules anastomose to form a plexus at the periphery of the dentin. This marginal lymph plexus serves to complete the circuit of the lymph stream and carries lymph which has come to it from the pulp along one group of tubules, to some other part of the dentin, whence it may return to the pulp down the tubules in that region.

4. A flow of body fluids has been observed to take place from the alveolar tissues across the cement into the dentin. The marginal lymph plexus

becomes filled with these fluids, whence they find their way down the tubules to the pulp and out of the pulp chamber by the apical lymphatic vessels to the alveolar tissues once more. A direct lymph path from the alveolus to the pulp along the dentinal tubules has thus been demonstrated.

5. The enamel has been shown to receive a considerable supply of lymph which penetrates it freely from the amelodentinal junction almost to the surface. This lymph supply is derived from the marginal lymph plexus of the dentin, whence tubules are seen to pass to the amelodentinal junction. At this point, these tubules give off fine branches to the individual enamel prisms.

6. The lymph in the enamel is rigidly confined to the peripheral layer of the individual prisms. The body of the prism itself and the interprismatic substance appear to be quite free from lymph. It follows from this that the enamel prism has an organic cuticle or sheath, but that the rest of the enamel is relatively inorganic.

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# BACTERIOLOGIC STUDIES ON DENTAL DECAY, WITH SPECIAL REFERENCE TO THE SPECIFIC PARTS PLAYED BY CERTAIN BACTERIA IN THE CAUSATION OF CARIES*

By T. OKUMURA, D.D.S., M.D., and B. NAKAI, D.D.S., Tokyo, Japan

THE fundamental research of W. D. Miller in 1890 theoretically solved the etiology of dental decay. He clearly postulated that certain acid-producing bacteria decalcify the hard dental tissues and prepare the tooth for subsequent invasion by various micro-organisms, and that the latter, in turn, produce dental caries. On the other hand, opinions differ among various investigators as to exactly what micro-organisms are actually concerned in the causation of dental decay. Goadby pointed out that, in the deeper layers of a carious dentin, *Streptococcus brevis*, *Staphylococcus albus*, and a Gram-positive bacillus, named by him *B. necrodentalis*, are present; while, in the superficial zone, several varieties of bacteria may occur which are not found in the deeper layers. At first, he believed *B. necrodentalis* to be the principal causative agent of caries, but later he abandoned this view in favor of the streptococcus, and his opinion was shared by Kantorowicz and Henrici. *Streptococcus viridans* was held by Hartzell and Baumgartner to be the cause of caries. Kligler constantly found *B. acidophilus*, *B. mesentericus*, and *Cladothrix placoides*, and less frequently also *B. putrificus*. The last alone possessed proteolytic properties. *C. placoides* displayed the greatest de-

*From the Bacteriologic Research Laboratories, Tokyo Dental College.

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calcifying power on the pulverized tooth, while *B. acidophilus* produced the largest amount of acid. Howe and Hatch maintain that *B. acidophilus*, *B. bifidus* and other members of the moro-tissue group are the only organisms found in a closed cavity, while McIntosh and Lazarus-Barlow isolated a member of the *B. acidophilus* group from decayed dentin and named it *B. acidophilus-odontolyticus*. They observed that, when a normal tooth was left in a culture of the organism for a long time, it underwent decalcification; bacterial invasion of the dental tubules took place, and caverns were formed. This organism has no proteolytic property. Rodriquez isolated three strains of a micro-organism, which he designated *Lactobacillus odontolyticus*, and he reports successful reproduction of dental caries under experimental conditions with his cultures. Clarke regards his *Streptococcus mutans* as the principal factor in caries production. Finally, Bunting and Palmerlee hold that *B. acidophilus* is constantly present in incipient caries and that when a circumscribed area of a tooth is exposed to the broth culture of this organism, definite caries develops.

The modern tendency is to regard the *B. acidophilus* group as the most important of the various organisms so far isolated from caries. *Bacillus necrodentalis* receives little or no attention, while *Bacillus acidophilus-odontolyticus* and *Lactobacillus odontolyticus* have arisen to prominence of late, and several varieties of streptococcus are claimed to have a relation to the production of dental caries.

We wish to report here, in the briefest possible way, the results of our own studies, which have been carried out during the past eight years. Our plan was to study *in vitro* the changes taking place in dental tissues, either intact, or partially or completely decalcified, when subjected to the action of the bacteria of the human saliva, and the experiments fell naturally into two groups. In one group, we employed impure mass cultures of the saliva or of a piece of naturally carious dentin; in the other, pure cultures of various bacteria which had been found to be associated, either constantly or occasionally, with carious conditions of the tooth. Sterilized bread or 1 per cent neutral glucose broth served as a culture medium, into which we inoculated saliva, infected dentin or various strains of micro-organisms isolated by us from normal saliva or from diseased teeth.

We have exposed to the action of pure or impure cultures normal tissue, either the whole tooth, or a limited drilled surface, the remainder being protected by paraffin or celloidin, in order to follow the changes which may be brought about by one or more micro-organisms. Needless to say, when a piece of dentin or a whole tooth is to be acted on by the bacteria in cultures for weeks or months, the culture mediums had to be renewed about once a week, in order that the organisms might continue to grow under optimum conditions. The action of bacteria on the test material (tooth, dentin, etc.,) was tested at a constant temperature of 37 C. The changes which followed in each mode of experimentation were studied microscopically by staining sections by Gram's method, carbol fuchsin being employed as a counter stain. The microscopic examinations were controlled simultaneously by cultural identification of the micro-organisms found in the tissues.

For artificial decalcification of the tooth, lactic acid was employed in concentrations of 3, 5 or 10 per cent. Preliminary decalcification was necessary in certain instances, in which the micro-organism lacked sufficient acid-producing power to decalcify the tissue, notwithstanding it might possess a powerful proteolytic property in acting on a decalcified dentinal matrix. Micro-organisms of this type may never be primary agents in dental decay, but may assume considerable importance as secondary factors once the way is prepared for them by acid-producing organisms.

In order to study the factor of discoloration in dental caries, we have added to the culture mediums, in some instances, two soya bean preparations, "shoyu," a liquid, and "miso," a paste, both of which contain dark brown pigment.

## SUMMARY AND CONCLUSIONS

1. The artificial decay of the tooth produced in a glucose broth culture of saliva or of a small fragment of the natural carious dentin is identical in every respect with the natural decay. After a period of 126 days at 37 C., the blocks of tissue showed a pronounced discoloration and decalcification. The enamel layer had entirely disappeared. The dentin showed microscopically an abundant bacterial invasion of the tubules, which were dilated and confluent throughout the section. Caverns were also formed, and sometimes large vacant spaces were discovered. A bread and saliva mixture produced similar but far less marked changes, owing, undoubtedly, to a poorer nutrient quality of bread, as compared with glucose broth, for the growth of the bacteria.

2. In the cultures, as well as within the affected dentin, two varieties of rod-shaped micro-organisms were constantly and abundantly present. One was Gram-positive; the other Gram-negative. Both have been isolated in pure cultures. The former, called *Bacillus P*, is nonmotile, acid-producing and non-liquefying, and is probably identical with *B. necrodentalis* of Goadby. The latter, *Bacillus N*, is motile and produces less acid, but has liquefying properties (i. e., it is proteolytic), but, so far, we have been unable to identify the organism with any bacterium previously described. *Bacillus N* showed a slight group reaction in agglutination tests with *B. coli communis*, but none with *B. coli communior*, *B. typhosus*, or *B. paratyphosus* A and B. *Bacillus N* and *Bacillus P* are both facultative anaerobes.

3. *Bacillus P* and *Bacillus N* can grow together, while staphylococci and streptococci can grow with *Bacillus N*, but not with *Bacillus P*, owing to the powerful acid-producing action of the latter.

4. *Bacillus P*, in glucose broth cultures, decalcified normal enamel and dentin completely in time. The blocks of dentin, when examined microscopically 134 days after being immersed in the culture, showed indistinct dentin structure. The tubules were dilated, and, in places, beaded, and were filled with the invading bacilli. There was no cavern formation. The findings, with artificially decalcified dentin treated similarly, were about the same as the foregoing.

5. *Bacillus N*, in glucose broth cultures, produced only a slight decalcification of normal dentin, and no marked structural changes of the latter were found, even after 151 days. On the

other hand, when a block of artificially decalcified dentin is placed in a culture of this organism, the bacilli penetrate into the deeper layers of the tissue and produce profound structural changes, giving rise to the caverns which are so characteristic of natural caries. This phenomenon has been observed only with *Bacillus N.*

6. Staphylococci, especially *S. albus*, which is an acid producer and a proteolytic agent, may play an important part in the formation of carious cavities by superficial dissolution of the dental matrix, but they do not reach the deeper layers of the dentin and can be regarded only as secondary invaders. Staphylococci scarcely touch the normal tooth, but they completely dissolve an artificially decalcified dentin within a short time.

7. Streptococci have a certain decalcifying effect but do not produce any structural changes of the dentin; hence, they may be regarded as an unimportant factor in the etiology of dental caries.

8. The frequent occurrence of an acute caries on the occlusal surfaces, as contrasted with the tardy evolution of decay at the cervix, may be explained by the ease with which the former localities accumulate fermentable foodstuffs, and their inaccessibility to prophylactic measures.

9. Discoloration of carious cavities is due to the absorption of certain pigments of food or drink by decalcified dentin. It bears no etiologic relation to the caries production by bacteria.

10. From these observations, we conclude that the far-reaching decalcification of the normal tooth is principally brought about by *Bacillus P* or *Bacillus necrodentalis* of Goadby, but that the deeper structural changes, such as are observed in the natural carious processes, are produced by *Bacillus N.* Staphylococci may be responsible for the formation of carious cavities, but streptococci seem to be least significant in caries production. Both groups of cocci are incidental secondary factors in the etiology of dental caries. *Bacillus P* and *Bacillus N,* which are always found together, but unaccompanied by other organisms, in the deeper layers of affected teeth, must, therefore, be regarded as the primary co-factors in caries formation.

# CONSERVATISM IN BRIDGEWORK*

By W. D. N. MOORE, L.D.S., D.D.S., Chicago, Illinois

DURING all the years that dental bridgework has been supplying missing teeth, probably at no time has this method of restoring lost teeth been so much discussed, nor have so many new ideas been propagated in connection therewith and so many new and varied methods tried, as have been observed in the last few years. These have been so rife as to cause bewilderment in all efforts to determine just what is the best course to pursue in this practice. All this recent infusion of new ideas and new methods emanated from the new era in dental practice, which began, it may be said, when the dental profession was all absorbed in the subject of focal infection and the condemnation, by some, of the pulpless tooth. In spite of all the advancement dentistry has steadily and surely made, never before has there been such a toll of sacrifice by its own hand as has been witnessed in recent years. As is usually the case, especially with the unscrupulous, all this alarm served as a disguise for much unnecessary extraction of natural teeth and the subsequent necessity for bridgework.

With the increase in the loss of natural teeth, there necessarily followed an increased demand for replacement, which was considered by the surgeons as a minor and simple procedure. Impressed as they were with the spectacular aspect of the work, there was an open disregard of the question as to what was to be done later for the patient's comfort. As a result of this situation, they predicted that the near future would see reparative work without the pale of dentistry, and those then doing it were referred to as "tooth tinkers." There was a complete loss of balance in the profession, with the result that more natural teeth were lost and more bridges made than ever should have been.

The aftermath was an infusion of ideas and methods for supplying lost teeth that were numerous and varied, each claiming superiority over the others, notwithstanding the fact that none of them had been tried a sufficient length of time to warrant any definite conclusions. "Necessity is the mother of invention," and so it was, when the pulpless tooth was condemned and only the vital tooth was considered as a supporting tooth for a bridge. A myriad of different forms of attachments were planned overnight, all claimed to sound forever the death knell of the pulpless tooth in its field of usefulness in bridgework, in spite of the convincing evidence of the long years of satisfactory

*Read before the Section on Partial Denture Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

service it had rendered. No contention is made that devitalization should ordinarily be made in connection with this work, but the sudden disapproval of the pulpless tooth brought about a confusion of ideas and methods, many of which, in practice, met with disappointment and failure. Conservatism seemed, at times, to have been entirely forgotten, and all that had proved of worth in years of comfort and satisfaction to patients now bore no significance nor warrant for the continuance of its use.

From my earliest knowledge of this branch of dentistry, I realized that bridgework had been, in a large measure, victimized, not only by dentists themselves, but also by dental laboratories and the advertising element of dentistry. One cannot help contrasting the practice of bridgework with that of operative dentistry, whose status has been acquired by the quality of men who early stood for its ideals in dental practice. While the aims and possibilities of bridgework are as meritorious as those of any department of dentistry, it is to be regretted that it does offer opportunities of a commercial nature and develops an inclination on the part of dentists to delegate its constructive part unreservedly to other hands; and these have, in a large measure, stood in the way of the greatest possibilities in its practice. Probably the most discouraging element that conflicts with elevating the status of the practice of bridgework is the tendency, on the part of many practitioners somewhat prominent in our profession, to regard the construction of bridges as of less interest and importance than operative work. Worse still, they have allowed dental laboratories, and agents of dental depots to dictate to them how bridges should be made. I have heard men eminent in dentistry say that the dental laboratories could make better bridges than could dentists themselves. Granting the truth of this statement, which I am unwilling to concede, it is a woful admission, reflecting no small discredit on themselves and dishonor on what is regarded as a learned profession. So depreciating were the remarks of some that four or five years was claimed to be the life of the average bridge. They were evidently not aware of the silent judgments passed on their own operations when such statements were made; for it is not unusual to find bridges that have served patients satisfactorily for upward of a score of years. A lack of morale such as many displayed, whether or not it was the result of their own experience or that of others, had an unhealthy influence on the practice of bridgework, particularly among the younger men, to whom must be accredited much of the enthusiasm and advancement of recent years. With these conditions somewhat prevalent, men who have been leaders in this work have had to struggle to maintain the ideals of which bridgework is worthy and to uphold the dignity of its practice.

The crux of the whole subject is the fact that there has not been the general acceptance of correct principles and methods, together with a sufficiently developed technic, that there has been, for example, almost the world over in operative dentistry, and, until this is accomplished, bridgework will be a more or less confusing subject. When acceptance of correct principles can be brought about universally, as in operative dentistry, the practice of bridgework will undoubtedly hold a place in dentistry secure from criticism.

There is no profession, or a specialty of one, that has enjoyed freedom from failure in its practice, and it would be disastrous for its future welfare if it had. This is the truly human element of it, which will never be otherwise. A close observation of things, over years of practice, will disclose certain attributes of men that have been accountable for their success or failure, and this has never been more vividly displayed than in the practice of dentistry. It is doubtful that there is any more valuable possession in the makeup of a professional man than good judgment. There is nothing that carries him through the hazards of practice with more safety and with greater surety of success than the possession of sound judgment. Where success in practice and loyalty of patients have been most enjoyed by members of our profession, it will be found that sound judgment is an outstanding quality, and it has been noticeably true that where an abundance of skill was possessed but good judgment was lacking, disappointment often prevailed.

Skill in any operation, directed by good judgment, is the most powerful attribute of man; yet, when misdirected, it fails miserably. The exercise of good, conservative judgment is imperative when the first examination is made in a case in which a bridge is to be considered. It may be conservatively said that right here success or failure is determined. Skill is necessary later, but now judgment plays the vital part. All that can be obtained from models, radiograms and keenness of observation should familiarize one with many of the characteristics and peculiarities that belong to the case. Without a full knowledge of these, the best results cannot be expected, and even where full consideration was thought to have been given, it is easy for something to escape our notice, but not that of the patient, later. The presence of something crudely fashioned and worn by the patient as long as tolerance could forbear, or even the presence, for long periods, of spaces where teeth are missing, often establishes certain habits, to change which, by the use of a well-made bridge, often proves a disturbance to the nervous patient, if extreme care and foresight are not given. Some mouths are very sensitive to alteration by bridges, and it is a wise operator who foresees all these conditions in advance.

There is more to be accomplished in successful bridgework than just supplying missing teeth. This may be done technically with reasonable skill, but may fail in its greatest possibilities for comfort and service to the patient. There is no denying the nervousness of some patients; but many have been unduly imposed on by improperly made bridges. Much could be gained in this work if we could only view things from the patient's standpoint. Sometimes, the removal of well fitted bridges is demanded solely for the reason that they were lacking in anatomic form, a condition that the patient failed to become accustomed to resulting in irritation. On the first examination of the case requiring a bridge, an endeavor should be made to visualize the arch with all the natural teeth present and then, as accurately as possible, to restore with a bridge that part where teeth are to be supplied so as to reproduce the arch as you have pictured it. To do this may necessitate changing, to some extent, some or all of the teeth opposing the space, which is fully warranted. This can be so well carried out that, a

day or so after setting the bridge, the mind of the patient of the keenest sensibilities is entirely unaware of the presence of anything new. This is the result that should be aimed for and is a fair test as to whether or not the effort has met with success.

For various reasons, probably no one part of the dental bridge has been more widely discussed or criticized than that which forms the means of its attachment to the supporting teeth. Particularly is this true since the warning has been sounded regarding the devitalization of teeth to be used for this purpose and the necessity of considering some form of attachment that will afford sufficient strength without interfering with the vitality of the pulp. This was a problem that was decidedly difficult, involving more or less cutting, often mutilating, of teeth to an extent that invited criticism beyond justification. There seemed to be a conclusion that, in order to supply one or two missing teeth, disaster had to be visited on one or two teeth, generally the latter. As an alternative, these spaces were often taken care of by means of partial dentures or allowed to go unsupplied with substitutes of any kind. Treating these cases by means of partial dentures usually brought about injury to teeth as well as much injury to the surrounding tissue. Thus, what was expected to conserve was a disappointment, and disaster was not avoided. To evade supplying the teeth that have been lost, especially in young patients, results, later, in a contracted arch, together with malposition of several teeth in that region. It is doubtful that any one omission of treatment has caused more havoc to the dental arch, particularly in early life, than the neglect to hold the space occupied by a natural tooth or teeth after extraction. So, with a keen and definite knowledge of all that is involved in the loss of natural teeth, particularly from the point of view of utility and preservation of the normal space in the arch, we are confronted with the inevitable—the construction of that which will best serve all requirements. Consequently, consideration of the tooth that is to serve as the supporting tooth must be without compromise, especially in vital teeth.

Previous to the condemnation of the nonvital tooth, probably the most common attachment used was the gold crown, together with other types of artificial crowns, especially on bicuspids and molars. While there is no gainsaying the fact that the gold crown has filled the requirement of strength in attachment, in a manner surpassed by no other type of attachment, yet its use is largely limited to pulpless teeth in the posterior part of the mouth. Despite its merits in this respect and the service it has rendered, it has not been free from criticism in regard to its irritation to the surrounding tissues of teeth. With its proper construction, irritation can be minimized. Nevertheless, any thickness of metal placed outside the tooth structure encircling in full or in part the circumference of the tooth in the gingival region conflicts with all theories of the present day that are correlative to the principles of focal infection. This, then, includes many types of attachments placed without the tooth structure. This class of attachment, in addition to its failure to comply with the laws of sanitation, presents a bulkiness about teeth and an irregularity of tooth form that is not readily

tolerated by all patients. The ideal attachment is that which is within the tooth structure and of correct anatomic form, no part of which offers any irritation to the surrounding tissues.

It has been said by eminent practitioners in the dental profession that no department of dentistry renders more satisfactory service to those we serve than that performed by the operative branch of our profession. There is much truth in this statement, for the reason that operative work deals with the requirements of individual teeth and is free from the complications involved when several teeth are brought into the field of operation. But one element of this conclusion cannot be overlooked, and that is the satisfactory service rendered by the properly filled tooth. Would it not be well, then, to employ the principles of the filled tooth? And a long step in the right direction ought to, and can be, taken in that part of the work that pertains to attachments for bridges, a truth generally conceded by authorities. With the splendid opportunities afforded when W. H. Taggart gave us the casting process, the gold inlay becomes an ideal attachment for bridgework. This, of course, does not include teeth destroyed beyond the possibility of inlaying. Further reason for its use is the frequency of occasions and indications that the inlay can be most satisfactorily used. It is interesting, on examination of cases, to note what a large percentage of teeth to be used as the supporting ones for bridges have already fillings of some sort, and frequently on surfaces favorable to bridge construction.

Probably no greater objection has been raised to the use of bridges than that so commonly heard—the mutilation of one or more teeth to replace an equal number. If this actually took place, such objection would be justified, but with the opportunities we have today, such argument is ill taken, particularly if a bridge is at all required. In the past, and even today, teeth have been sacrificed for the sake of bridge construction, but judgment or technic, or both, were at fault rather than principle. The removal of old fillings, often improperly inserted, from the supporting teeth, and proper preparation of cavities for gold inlays, carefully made, will render to these teeth a service equal to, and often greater than, that which could ever be hoped for from those replaced. This, then, should relieve the mind of any scruples that it may have concerning the mutilation of supporting teeth for bridgework. The supreme plea that I wish to make, particularly in regard to this important part of bridge construction, is that a careful study of the conditions present be made and that the procedure of operation be so planned and mapped out that the supporting teeth, on completion of work, shall be left in a no less favorable condition for comfort and service than before the work was attempted. This being our aim, little fear need be entertained in this particular part of bridgework. Years of experience and close observation have borne conclusive evidence that supporting teeth in bridgework that previously had only ordinary amalgam fillings, which were replaced with properly made gold inlays, not only served as a means of supplying lost teeth but were themselves much improved by what had been done. This statement may arouse some comment, but it is a truth not to be denied.

Mutilation of teeth need not play any part in the properly constructed attachment for a bridge, and when it does, technic is usually responsible. When we consider the increased efficiency that can be afforded by the use of an inlay in restoring the occlusal surfaces of the many tipped supporting teeth, where nearly all of the occluding surface has been lost to service, this means of attachment, together with restoration, demonstrates in a most convincing manner what gratifying results can in this way be obtained.

The supporting tooth for a bridge that is most likely to present a problem is the vital tooth that is free from decay, and without a filling, and has, as is seldom the case, retained its proper place and position in the arch. This condition, which is typical in young mouths, is found soon after the loss of one or more teeth. Uncared for, it means a derangement of both arches that will in time be serious. Such spaces should, as soon as possible, be supplied with a bridge to maintain the space in the arch as well as to prevent elongation of teeth opposing the space. These cases are too often neglected, with the result that, in later years, treatment is imperative and much more difficult. They should be taken care of as early as possible, if the best results are to be expected, and an inlay, properly constructed in every detail, will best serve as a means of attachment for a bridge, with least destruction or disturbance of the tooth. In these cases, there has been an inclination on the part of both dentist and patient to make a bridge of a removable type with clasps. This only means putting off the evil day, and those who have ever had to handle these cases after decay has extensively invaded those areas covered by clasps well know what a task is encountered. The work is much better done in the first place, and, when it is done carefully and accurately, permanency can be assured. Lack of confidence on the part of the operator, together with a protest from the patient, usually accounts for these cases being allowed to go on until much trouble has resulted, and the trouble that has arisen from even the space of one extracted tooth, particularly the lower first molar, not being maintained has been the cause of more disastrous conditions in the human mouth than any other one practice in dentistry.

As this is not a technical paper, it is important that reference be made to some of the essentials to be observed in an inlay used for an attachment for bridges. A clinical demonstration would give better results. An inlay without more strength of attachment than the ordinary inlay used in the filling of teeth would not be sufficient for use in bridgework. Cavity preparation must be carried out in every detail, together with liberal extension, which provides for a broad and firm seating of the inlay. The bases and walls of a cavity should be flat and definitely formed, with angles made slightly larger than a right angle and well shaped. In bicuspids and molars, extension on occlusal surfaces should be made to the buccal and lingual walls and, where necessary, should include these in part. In areas most remote from the pulp, small iridioplatinum pins, from 2 to 3 mm. in length and from 20 to 21 gage in thickness, should be employed to insure stability in attachment, the principle being that a short pin, carefully and accurately fitted in tooth structure, is stronger in its attachment than a long pin loosely

fitted. Experience in removal of an inlay so inserted will amply prove the truth of this statement.

While I make a strong plea for the attachment that has its place within the tooth structure rather than on the outside, I fully realize that there are cases in which other means must be employed. To meet all conditions with the greatest success, many different types of attachment must be used, the operator always keeping in mind the employment of that which most closely approaches natural conditions and thus conflicts least with sanitary conditions of the mouth.

One of the great evils that have prevailed in the practice of bridgework is the tendency to fix one type of attachment to nearly all teeth, due to the enthusiasm and teaching of its early advocate. To accomplish the greatest good in this work, resourcefulness and ingenuity are wonderful assets for any operator. Without these, the greatest results cannot be expected, and in this field lie possibilities that are of the greatest interest. This is especially true in constructing attachments to be used on anterior teeth, where the esthetic plays such an important part, and a part that must be kept in mind in posterior work. To assure ample strength and yet not proclaim to the world the presence of dental work, and it can be done, is an art that can be effected only by a skilled hand and an ingenious mind. To detract unnecessarily one iota from the natural appearance of a patient's beauty is no trivial error, and yet it is shocking to what extent dentists have erred in this respect. The assignment of much of this work to dental laboratories is responsible for a vast number of these unsightly restorations. The wonder is that these places do as well as they do, since they rarely ever see the individual for whom the work is intended—a knowledge which is essential for anything like an esthetic result. The esthetic requirements of this work are most interesting, and much satisfaction to both operator and patient could be gained if only close application to this part of the work could be stimulated. It has at times been so neglected that it is a discredit to dentistry.

In recent years, considerable enthusiasm was manifested on the part of some members of the profession on behalf of the removable type of bridge. It was designated in some instances by a nomenclature possessed of neither professional dignity nor euphony, but since "there is nothing in a name," this should not be taken seriously or be made to detract in any way from the merit such type of bridge might possess. As is usually the case with the advent of new methods in the practice of a profession, the use of the removable bridge was heralded with overenthusiasm by some, and an unfavorable reaction has been the result. There is no better illustration of the value of conservatism than was presented when the removable type of bridge was claimed to replace fixed bridgework. It only requires time for such adventures to run their course and naturally seek their proper level. It is extreme folly and lack of conservatism to expect any one method to meet adequately all conditions in practice. Since many theories were expounded concerning fixation of teeth by the use of fixed bridges, it was the greatest mystery how this type of bridge ever did satisfactory service for so many years, and not until the findings of Dr. Hardgrove were published was the explanation scientifically made. There is a place in prac-

tice for the removable type of bridge. As I have previously stated, "The removable bridge begins where the fixed bridge ends;" in other words, where the strain to be exerted on a fixed bridge would, by conservative estimate, be greater than the resistance to be expected of the supporting tooth or teeth and their normality be maintained, the removable bridge has a field of usefulness and meets certain conditions and requirements most admirably.

My plea today is that dentists throughout this land and all other lands consider this subject on a higher plane than it has been considered in the past, to the end that people may be better served than they have been during all these years that its practice has been hampered by irrational methods, by commercialism, by fads and by a general half-hearted interest in its practice. Not until we free it from the bonds that have fettered it so long can we claim to be, in the fullest sense of the word, truly professional men, having at heart the best interests of those we serve.

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# ARCHITECTURAL BONE CHANGES OF FACE AND CRANIUM*

By GEORGE S. MONSON, D.M.D., F.A.C.D., St. Paul, Minnesota

ARCHITECTURAL bone change comprises a study from the prenatal period to late adult life. For the observance of form of face and cranium, it is only necessary to begin with a subject at birth. (Fig. 1, *A*.)

It will be noted that the child at birth has a rounded contour of face and cranium, lacking the characteristic angles that are developed by muscular action. The nose is but a diminutive thing, having little bridge and small nostrils. The chin does not manifest itself distinctly at this age, and the general appearance is lobular.

The child, at this period of life feeds, by the function of sucking, which produces the first stress on bone through muscle action. The orbicularis oris, buccinator, superior, middle and inferior constrictor muscles, working coordinately with the palate muscles, muscles of the tongue and other associated muscles, produce a partial vacuum or a negative pressure in the oral cavity, which is the function of sucking.

Keith[1] interprets Wolff's law as follows: "The external form and internal structure of living bone change with every alteration of function; that is, a bone has the power to adapt itself to the burden it has to bear." To Wolff, living bone was a plastic tissue, in which demolition and rebuilding were taking place in all parts.

According to Wolff's law, the char-

*Read before the Section on Full Denture Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

1. Keith, Arthur: Menders of the Maimed, Oxford Medical Publications, London, Frowde and Hodder and Stoughton, 1919.

acteristic change in architecture of bone, evidenced by the increase in angularity of face form from infancy to childhood, is due to food change from liquid to solid, as occlusion of teeth develops, along with an increase in muscular stress on the bone. (Fig. 1, *B*.)

We will note that the facial bones have changed in their form. The nose is developed to a considerable extent, and the chin is more definite. With the deciduous teeth in position and in-

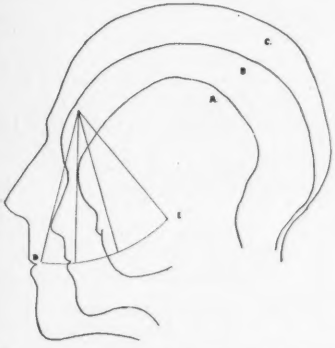


Fig. 1.—Comparative growth from birth to adult life, using the occlusal mandibular area as base. *A*, at birth; *B*, at 5 years; *C*, in the adult.

tercuspated, which is essential to the proper relation of the bones in their development, any change from the original natural order, either by loss of teeth by decay, extraction or habits, alters the functional stress put on the muscles, and disturbs the relation and development of not only the facial bones, but those at the base of the cranium as well. It is from this period on that the most marked evidence of inharmonious development of the bones of the face and base of the cranium will be observed.

The full and definite characteristic angles of any individual's face should be complete when the third molar erupts. (Fig. 1, *C*.) The arced line *DE* represents the line of occlusion, which I wish to maintain at this time is the neutral zone through all stages of face and cranium development.

In considering the architecture of the bones of the face and cranium in the time allotted, it is impossible to cover any more than one section of the subject; hence, I shall confine my discourse to the mandible.

Before proceeding, it may be well

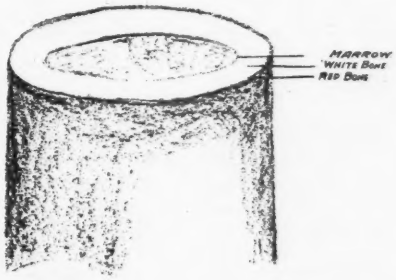


Fig. 2.—Diameter growth of long bones. The first cross-section as described by Duhamel.

to consider the laws governing the growth of bones. I shall quote from Richard E. Scammon's[2] unpublished research work on bone growth.

The form, and to some extent the structure, of bones was studied in detail long before any attempt was made to formulate even working theories of their method of growth and transformation. The increase in the size of the bones, as well as their repair after injury, was explained as due to the flow of some formative substance, which was generally thought to be resident in the blood, to the area at which the increase was taking place, or at which the repair was to be made. The earlier students of bones thought of the bone

2. Scammon, R. E.: Development of the Laws of Bone Growth.

marrow only as a packing substance to fill the spaces between the hard part of the structure, and they considered the periosteum only

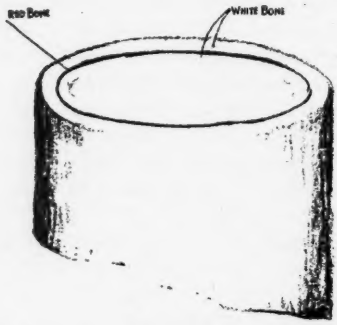


Fig. 3.—Second cross-section of a long bone.

as a limiting membrane having no more to do with the bone itself than the capsule of a gland does with the function of such an organ. The first advances were made in the knowledge of the living structure of bone

Fig. 4.—Third cross-section of a long bone, showing the migration of the madder-colored bone from the outer surface to the inner.

when experimental methods for its study became available.

The first of these methods was discovered quite by chance. In the year 1768 there lived in London a calico dyer, and the chief activity of his trade was dyeing cloth a color known as Turkey red. This color was imparted to the textile by the use of a solution

Fig. 5.—Hunter's silver ring as applied by John Humphrey to the mandible.

of the madder plant which was grown for this purpose throughout southern Europe. The madder was soaked in vats with bran, and the cloth dyed in this mixture. After the cloth had been dyed, it was the custom of the dyer to drain off the superfluous fluid and feed the stained bran to pigs, and, being

Fig. 6.—Condition two weeks later.

a hospitable man, he generally fed the pigs to his friends. In the year above mentioned he had at dinner a young surgeon named John Belchier, who noticed, when the joints were carved, that the bones had a distinct reddish color, which he surmised was due to the effect of the animals eating madder. On

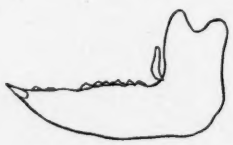

Fig. 7.—Silver ring free from the bone and in the soft tissue, in the last animal killed.

the basis of this guess he performed a series of madder-feeding experiments, and showed definitely that when animals were fed this substance the bony material formed during the feeding period would be dyed red.

Belchier carried this experiment no farther, but the study was taken up somewhat later by the scientist Duhamel, in France, who fed madder to growing animals with the point in

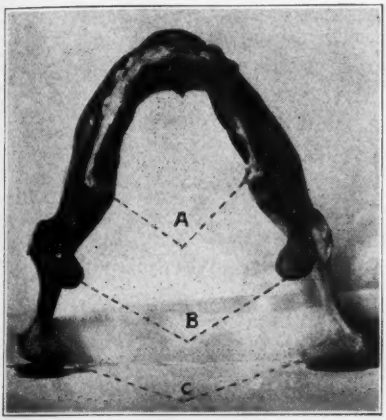


Fig. 8.—Three superimposed mandibles from birth to adult life, showing the angle at the symphysis to be the same.

view of determining how bone was laid down in the skeleton. His critical experiment was as follows:

Taking several litters of young pigs, he killed one or two animals, cut cross sections of the long bones, and showed that they were white throughout. He then commenced adding madder to the food, and at the close of a fortnight killed another animal and examined the long bones in cross-section. These showed an inner circle of white bone, which was present when the experiment began, and an outer circle of red bone which had been deposited during the feeding period. (Fig. 2.)

He then ceased feeding the madder, and allowed the animals to live a few weeks longer. Then, killing another, he found that the long bones on cross-section showed an outer zone of white bone, a middle zone of red bone, and a very narrow inner zone of white bone. (Fig. 3.)

The outer zone of white bone was evidently laid down after the experiment had been concluded. The red bone represented the bone deposited during the feeding, and the small inner rim of white bone represented the remainder of the bony tissue which was present before the experiment started.

Killing animals at a later period he found that the outer zone of white bone was very much thickened, the middle red zone was somewhat reduced, and the inner white zone was entirely gone. (Fig. 4.)

Animals killed still later, when approaching maturity, showed only the white bone of the outer zone; the middle red and the inner white had completely disappeared. Thus he had demonstrated conclusively that the growth of the bone in thickness took place not through the expansion of the bone within itself—that is, by interstitial growth—but by the addition of bone on its outer surface and the absorption of bone on the inner surface; in other words, by apposition.

These experiments were later repeated by a noted English surgeon, John Hunter, who not only fed madder but also performed what is known as the "silver ring experiment." Taking young animals, he exposed the shafts of the long bones, cut away a little of the periosteum, and bound closely about them circlets of silver wire.

Killing some of the animals a little later, he found that the wire no longer lay on the

Fig. 9.—Conformity of prenatal mandibles to the equilateral triangle.

surface of the bone, but was imbedded within it.

Other animals killed at a still later period showed the rings well inside the bone, close to the margin of the marrow cavity; and others killed still later in the experiment showed the ring lying loose within the marrow cavity itself. Thus the silver ring had apparently passed through the bone of the shaft during the period of experiment.

Evidently what had happened was that the bone increased in thickness by piling bone over the outer surface of the ring, and the marrow cavity kept pace with this growth by the absorption of bone on the inner surface, until finally all the bone originally surrounded by the ring was removed, and all the bone which formed a new shaft was laid down after the experiment began.

John Hunter carried his experiment still farther, for he realized that it was quite as important to determine the method by which bones changed in form as it was to determine the way they grew in size. He proved, by inserting ivory pegs into various parts of living long bones, that the growth of these bones in length was due to the laying down of bony substance between the main part of the bone, or shaft, and the caps of bone, or epiphyses, which are found at the ends of these shafts, and he showed that when the plates of cartilage which lie between the shaft and epiphyses have exhausted their growth there can be no further increase of the length of the bone.

Fig. 10.—Mandibles from birth to 5 years of age showing conformity to equilateral triangles.

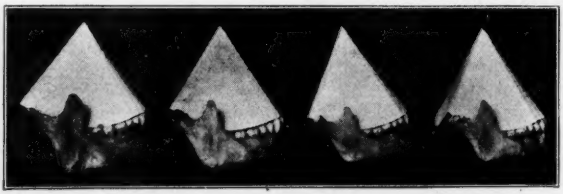

Fig. 11.—Right side view of adult mandibles conforming to a sphere.

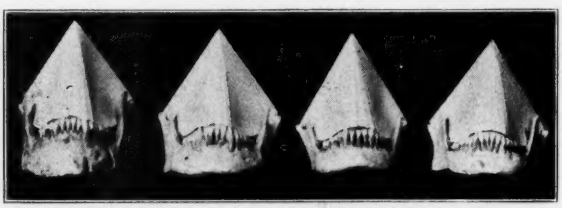

Fig. 12.—Front view of mandibles shown in Figure 11.

But this did not explain the change in form of bones which do not have epiphyses; such as, the bones of the skull and face. To study these bones he made recourse again to madder-feeding experiments, and studied particularly the mandible. Here he determined that not

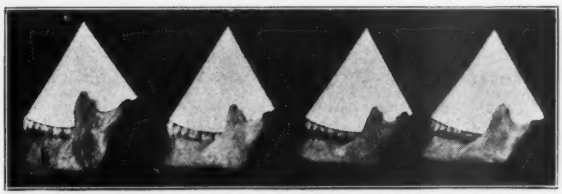

Fig. 13.—Left side view of mandibles shown in Figure 11.

only was the size of the mandible increased by the laying down of bone on its exterior and absorption on its interior, but the form was changed by localization of the activity of this process. Thus he found that bone was being built up on the back of the ramus of the mandible with great activity, but that along the front margin of the ramus the activity was one of absorption and not deposition, and as a result the ramus of the

English surgeon Humphrey, who used a modification of John Hunter's "silver ring experiment." Humphrey took a series of young animals, exposed the vertical ramus of the mandible in each case, and fastened a single silver ring about it. (Fig. 5.)

He then killed these animals at various periods after the experiment began. Two weeks after the original operation he found that new bone had been built up on the jaw behind the ring, but the front end of the ring projected free from the front margin of the bone into the surrounding tissue.

A few weeks later the posterior margin of the ring lay in about the middle of the ramus

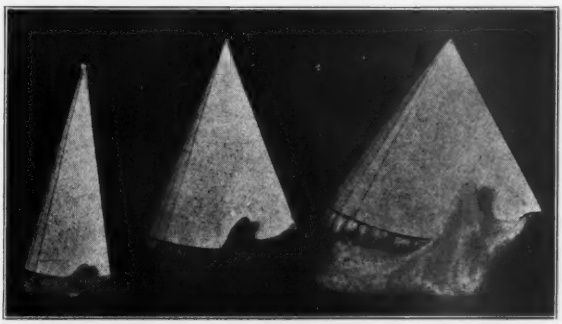

Fig. 14.—The mandible at birth, at five years of age, at adult age, showing conformity to the sphere.

mandible moved backward in the facial skeleton, and the space between the symphyses and the ramus was increased to accommodate the erupting teeth.

The most convincing experiment on the growth of the mandible, however, was performed a good many years later by the

of the mandible, and its entire front half was free. (Fig. 6.)

Still later the ring lay entirely free from the bone in the soft tissue in front of the ramus. (Fig. 7.)

This meant, then, that during this period the ramus had been entirely reconstructed;

that all of the bone originally enclosed by the ring had been absorbed from its anterior surface; and that the new ramus was made up entirely of bone which had been built behind the original ring. These experiments, as well as numerous others of the same type, established clearly the methods by which bones grew in size and were transformed in contour.

The growth and architecture of the mandible as part of the masticating

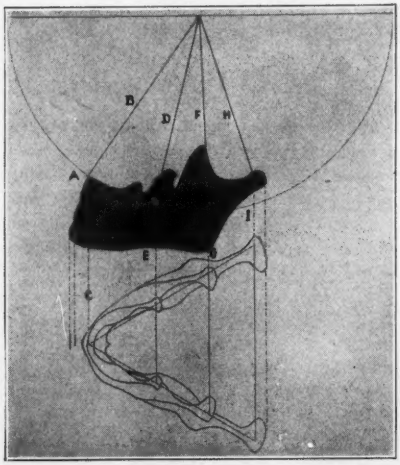


Fig. 15.—Side elevation showing the comparative growth from birth to adult age, and a projection to the occlusal mandibular area showing the comparative growth in this dimension.

mechanism follows a definite law, as will be observed in the following group.

The three mandibles shown in Figure 8 are superimposed one on another: *A*, at birth; *B*, 5 years of age; *C*, about 35 years of age. It will be observed that the general form is the same in all three mandibles. The mandible at birth has the same angle at the symphysis as the one at 5 years of age, and the angle is the same in the fully developed mandible when there has been no loss of teeth.

If we examine a group of prenatal mandibles from 3 to 9 months, as in Figure 9, we shall find that they all conform to equilateral triangles.

If we examine a group of mandibles from birth to the age of 5 years, as in Figure 10, we shall note that each of these mandibles conforms to an equilateral triangle. Such being the case, it is logical to deduce that throughout

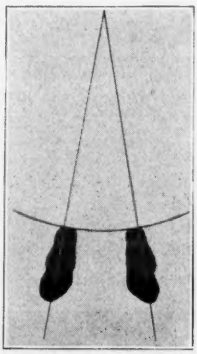

Fig. 16.—The vertical growth of the mandible from 5 years of age to adult size, showing the direction of growth of bone to sustain muscular action.

life these angles will be maintained if no abnormality is produced by the loss of teeth, or discomfort in teeth or investing tissue. A habit of chewing on one side at any period in life, and especially during the years of development, necessarily produces greater muscular energy on the side used, which, in turn, is a stimulus to a materially increased growth of bone on the same side. On the opposite side, where function is incomplete, we see a lesser muscular development, and, in consequence, a perceptibly smaller amount of bone

growth. This accounts for the large number of specimens obtainable which do not have an equilateral triangle. With mandibles of equal angles at the different periods in early life and through the periods of an increasing mandibular occlusal area, it is evident that the architecture begins and continues with a definite plan throughout life, unless interfered with by loss of teeth, poor dentistry or disturbed metabolism. It is not difficult to find mandibles with sixteen teeth and a triangle with equal sides, for I have a number in my own possession and know of many others. (Figs. 11-14.)

I mention this fact because of an article published recently in THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, in which there was illustrated a great array of mandibles that were deformed or considerably changed from the form found early in life. I infer that the writer of the article considered the specimens shown as being norms and that no changes had taken place. He also implied that there is no occlusion conforming to the sphere, and that no mandible conforms to an equilateral triangle. I am merely trying to call attention to the fact that many investigators apparently mix certain data; which produces confusion in the mind of the reader.

My conception of a norm in the architecture of occlusion is a spherical base with one common center toward which all forces are directed. It is the form that can maintain longest the equilibrium of all associated parts. There are other forms that are unanimously conceded to be abnormal, and it is this fact that has developed orthodontia.

In Figure 15, it will be noted that the three mandibles in profile conform to a spherical pyramid with a radius of 4 inches, and this supports the fact that the occlusal surface of the teeth and temporomandibular articulation is a neutral area, from which the vertical development of the bony framework takes place. That is, the superior maxillary bone develops upward from the occlusal surface, thus supporting the developing teeth as the force of mastication is applied by the muscles. As the immature mandible develops, the bone increases downward to support the developing teeth. The mandible, in development, is apparently carried forward, the breadth between the condyles increasing as the body and ramus are developed. The distance from *I* to *E* shows the amount of growth anteroposteriorly. It is also evident that the breadth between the condyles is increased coordinately, the same angles being maintained to the Bonwill triangles.

By placing the mandible of a new born child, one of a 5-year-old child, and one of an adult, on a sphere, as shown in Figure 15, with the symphysis of the first, and the mesial angle of the central incisor of the other two, on angle *A* and *B*, the line *C* becomes a projecting line to the mesial incisor angle of all three mandibles.

*D* is a radial line passing from the center of the sphere to the condyles of the mandible at birth; *E*, a projecting line from the condyle to a line forming the hinge axis of the mandible; *F*, a radial line from the center of the sphere to the condyles of a mandible at 5 years of age; *G*, a projecting line from the condyles to the hinge axis of the same mandible; *H*, a radial line from the center of the sphere to the condyles of

a fully developed mandible; *I*, a projecting line to the hinge axis of this mandible.

This illustration will give a comprehensive picture of the growth of the mandible in profile, as well as of the occlusal mandibular area, showing the early mandible carried forward as the breadth between the condyles is increased. It also shows the development of the chin. All three of these specimens have equilateral triangles.

The silhouette shown in Figure 16 is made by placing on a sphere the mandible of a 4-year-old child which has been cut through the molars, and a fully developed mandible cut through the bicuspids. The lines of stress are shown from the center of the sphere.

Recent researches have convinced me that the tendency of development of the mandible is along the lines of an equilateral triangle, with the occlusion of the teeth as the neutral zone in the vertical growth. The fact that the younger the specimens examined are, the larger is the percentage that conform to the rules, would indicate that this is Nature's plan, and is changed only when there must be an accommodation to a functional disturbance. This departure from the symmetrical in development is brought about by adaptation of muscle-pull to accommodate itself to some abnormality or mutilation, usually in the occlusion, and as the form of the bone changes to meet the strain put on it by the muscles, we must consider the asymmetrical development a deviation from the normal.

## CONCLUSIONS

1. Nature has a definite plan in her architecture, as evidenced in the early forms of the mandible.

2. The disturbance of the lines of muscular stress, due to some impairment in function, produces asymmetry.

3. Muscular action is the stimulus to bone growth, and affects form and interrelationship.

4. The growth of the mandible is coordinate with the growth of the muscles acting on it.

5. The loss of the interposing occlusion of the teeth is the major cause of asymmetry of the mandible.

6. If the occlusion is restored, permitting full range in function in mastication and deglutition, the mandible will, by the same token, resume its former form and relation, as bones do change according to muscle stress, normal or abnormal.

# EVERYDAY PROCEDURE IN MINOR AND MAJOR SURGERY OF THE MOUTH UNDER NITROUS OXID-OXYGEN ANESTHESIA*

By CHARLES K. TETER, D.D.S., Cleveland, Ohio

IN presenting this subject, it is my desire to make clear our procedure as applied every day in the handling of patients, and the technic of anesthesia as applied to different operative procedures.

A day in the office of a dental or oral surgeon differs from one in the office of a dentist practicing general dentistry and is perhaps more interesting. The specialist is continually meeting new faces and problems. It is quite obvious that, from the nature of the work, the same patient does not often return; while, with the dentist, practice is built up and continued to a great extent with the same people, with whom he becomes acquainted and whose temperaments and idiosyncrasies he learns.

The specialist, in his preoperative work with a patient, must rely on his reading of human nature, and, with the everchanging faces which each day brings, this becomes an easy study.

I wish to emphasize the fact that all our operations are done under nitrous oxid and oxygen alone and that continued anesthesia is maintained until the completion of the work, irrespective of the length of time.

I have not had more than five or six cases out of more than 80,000 in which it was necessary to discontinue the anesthetic before the operation was completed. So I can safely say that we continue the anesthetic until the work is completed.

I shall review briefly the principles involved in the scientific administration of nitrous oxid and oxygen: 1. The administration of a preanesthetic narcotic when the gas is used as the anesthetic in major surgery, but not in minor or dental surgery. 2. The advantage of oxygen over the atmospheric air because of the small percentage of pure oxygen in the air. 3. The necessity of accuracy in dosage, which is made possible by positive, definite and even flow of the gases. This will produce an even and safe anesthetic, which is void of intercurrent asphyxia and nausea. 4. The advantage of administering gases warm, because they are more readily absorbed, and all refrigerant effects, with resultant irritation, are removed; which results in quicker induction, more profound anesthesia and conservation of the body heat. 5. The rebreathing of the gases because of the great saving in the amount of the gases used, and the conservation of the nor-

*Read before the Section on Exodontia, Anesthesia and Roentgenology at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

mal amount of carbon dioxid in the system during the anesthesia, this preventing a certain amount of shock. 6. The advantage of utilizing intrapulmonary pressure of the gases, thereby causing a greater absorption of the gases, and preventing dilution by leakage of air.

When properly administered, nitrous oxid-oxygen is the safest anesthetic known, because it does not cause irritation to or decomposition of any tissues or elements of the body. Lung complications are never met with, and I have administered the anesthetic to three patients during an acute attack of pneumonia without in any way making the patient's condition worse. On the contrary, the condition of all the patients improved markedly almost immediately after the anesthesia. Warm gases and a nonasphyxial narcosis was responsible for this, I believe. The anesthetic was not administered as a treatment in these cases, but because it was essential to operate in order that the patients' lives might be saved, one a case of acute appendicitis, and two, strangulated hernia. All three patients recovered. I also have administered this anesthetic during severe attack of diphtheria, to a young man who was so unfortunate as to have, at the same time, acute appendicitis. He made an uneventful recovery. I have administered gas anesthesia many times to old people suffering with practically all the complications associated with their age, such as arteriosclerosis, nephritis, diabetes, myocarditis and high blood pressure. I have not seen postoperative suppression of urine in any case; no deleterious effects followed the administration to diabetics in a single case, and no complications have ever followed its administration to patients with an abnormally high blood pressure, hardening of the arteries and a diseased heart. In fact, the worst surgical risk seems to tolerate the nitrous oxid plus plenty of oxygen better than the strong and vigorous patient.

The safety of nitrous oxid anesthesia depends almost wholly on the man administering it, for the dangers are technical only, and the extent of controlability depends on the efficiency obtained by the administrator.

While it is important that the anesthetic agent selected be the right one as regards the nature of the operation and the physical condition of the patient, just what the right one will be depends more on the ability of the administrator with the different anesthetic agents than on the agents themselves. The limitations and dangers of the different anesthetic agents are more or less generally known, but the limitations and dangers of the administrators are an unknown quantity. Therefore, whatever may be the agent used, its limitation is regulated to a great extent by the expertness or lack of experience on the part of the administrator.

When an appointment is made, the patient is requested not to eat for five or six hours before coming in. Before entering the operating room, the nurse ascertains whether the bladder has been emptied. Collars should be removed. neck bands and other tight clothing loosened. The patient should take a comfortable position in the chair, with the head in a straight line with the body, care being taken that the head is not too far back or forward, as either posture has a tendency to obstruct breathing. With the patient in the proper position, the nasal inhaler is adjusted, the operator using his thumbs to spread the lower part of the rubber hood, in order to prevent the partial obstruction

of the nasal passages. Sometimes, almost complete nasal obstruction is met with, which makes it impossible to induce anesthesia through the nose. These cases are rare, but when we do meet such conditions, the face inhaler is used for the induction, after which anesthesia is continued with the nasal inhaler or pharyngeal tube, and the gases are forced.

The patient is instructed to take deep inhalations, relaxing and breathing regularly, and trying to go to sleep naturally. The nitrous oxid is turned on and allowed to flow just before the inhaler is applied. There should be sufficient gas flowing to keep the bag well distended at all times. The mouth prop should be inserted immediately after the inhaler is applied. After five or six inhalations, the oxygen is started, slowly at first, but gradually increased, as asphyxial symptoms develop, such as cyanosis jacitation of the muscles, the turning down and inward of the eyes, all of which are indications of lack of oxygen. If mouth breathing is noticed after patient has been instructed to breathe properly, a rubber cover is placed at once over the mouth, and it is held on in order that there shall be no leakage. This will compel nasal breathing.

When sufficient depth of anesthesia has been obtained, which will be after from one to two minutes, the rubber cover is removed from the mouth. Breathing through the mouth, should it continue, can usually be controlled by packing with surgical sponges. Care must be taken that these sponges are not packed too far back as the soft palate or tongue will be forced against the posterior pharyngeal wall, thus obstructing the nasal passages. There are some cases in which mouth breathing cannot be controlled entirely by the use of sponges, and in these cases, we close the exhalation valve entirely and force the gases through the nasal passages under sufficient pressure to exclude the atmospheric air. The patient is then compelled to receive the gases into the lungs, even though he is inhaling and exhaling through the mouth. Less oxygen may be necessary under these conditions than if the patient breathed continually through the nose, as a certain amount of air may be admitted to the lungs. By continually forcing the nitrous oxid and controlling the asphyxial symptoms with the oxygen, the patient may be kept anesthetized for any length of time necessary to complete the work. Should the patient continue to breathe through the nose and not the mouth, it will not be necessary to force the nitrous oxid. A continuous flow, as during the induction, will carry the patient along for some time, and this may be reduced as the anesthetic is continued, for more gas is necessary proportionately for induction than for continuation.

In the majority of cases, this technic will produce an even and quiet anesthesia, but, unfortunately, we have cases that tax our ability and resources to the utmost; patients perhaps who have extremely nervous temperaments and will be very much frightened. It is a peculiar fact that even the average patient is more frightened when he sits in a dental chair to have a tooth extracted than he is when he comes to the operating room in the hospital for a major operation. He has not had the preliminary preparation that he would receive before such an operation, and he is therefore in a higher state of nervous tension.

The alcoholic, the strong, vigorous, out-door man, the excessive smoker and

those addicted to taking narcotics are the most difficult to anesthetize, especially with nitrous oxid and oxygen. It is out of the question to obtain a quiet, profound anesthesia in such cases. These can be anesthetized successfully, and all dental extractions and oral operations be performed painlessly without preliminary narcotics, if attention is given to every detail, and sufficient time is taken to produce complete anesthesia before beginning to operate.

Should an adult patient object seriously to taking the anesthetic or refuse through fear or nervousness to comply with instructions, it is better to dismiss him for that day, to return voluntarily later. It may be advisable in these exceptional cases to administer hypodermically one-eighth to one-quarter grain morphin sulphate and one two-hundredth atropin.

We will take for our first subject one of these strong vigorous types unusually hard to manage.

Mr. S., aged 65, a man weighing over 200 pounds, came in for the extraction of all his teeth, which were in a badly diseased condition. The nurse having had his coat, vest and collar removed before he was seated in the chair, the gas was turned on, the nasal inhaler adjusted and the mouth prop immediately inserted. The patient was instructed to breathe deeply, relax and sleep. After five or six inhalations, he became violently excited and reached up, tearing the inhaler and mouth covering from his face. The combined efforts of three of us were required to keep him in the chair and prevent his destroying the place. In two or three minutes, he was fully himself and much chagrined and humiliated at his conduct as he was conscious of the fact that he was fighting. He then informed me that there had been numerous efforts made to administer nitrous oxid and oxygen to him, and all attempts had been complete failures because of the violent struggling which took place before anesthesia could be induced. As he was very anxious to have the teeth removed painlessly, he agreed in the second attempt to follow my instructions exactly.

I told him that I would use the face inhaler and he could breathe either through the mouth or the nose and for him to imagine that he was attending a church service and must keep quiet. The face inhaler was adjusted, nitrous oxid was allowed to flow freely, a few words of encouragement were spoken, and he passed into the anesthetic state without a single movement. Deep anesthesia was secured, taking about three minutes. Only sufficient oxygen was used to overcome asphyxial spasms. At this time, the face inhaler was removed and the nasal inhaler adjusted, the gases being forced through the nose and the mouth packed with sponges. Anesthesia was maintained without difficulty until all the teeth were removed and sockets curetted, and the process was trimmed and smoothed. The patient recovered consciousness within one minute and was able to leave the office within fifteen minutes, feeling very grateful.

The objections to multiple extraction for the same case have gone far enough in the dental profession, for it has no counterpart in any other branch of surgery, with a few exceptions, such as ligation of the thyroid with subsequent removal.

There would be as much reason to advocate the removal of one tonsil when both are diseased, or performing a unilateral mastoid paracentesis when a bilateral infection is present. In administering the anesthetic and assisting the surgeon in about 20,000 cases of tonsillectomy, there was only one case in which one tonsil was left in, and this was due to imperfect technic in controlling hemorrhage. In acute infection, this is another proposition, which will be taken up later. Teeth showing an infection of long standing, and all those that may not be treated should be removed; and if nitrous oxid-oxygen is the anesthetic used, and it is administered as it should be administered, there is no justification in sub-

jecting that patient to the nervous ordeal of multiple operations. During the past twenty-five years of my practice, I have not found one patient in 5,000 who was not physically fit to go through the operation at one sitting. The effect of the knowledge that all operative procedure is over more than makes up for any deleterious reaction from toxic absorption.

### PROPER PROCEDURE DURING ACUTE INFECTION

Owing to a deep seated and antiquated tradition, there exists in the minds of many lay people and also in the minds of some of the members of both the dental and the medical profession the belief that to remove a tooth while acute symptoms are present will probably cause septicemia. The experience of oral surgeons generally does not coincide with this view, for it has neither a pathologic nor a surgical foundation.

To establish drainage is called for, and usually this may be done by the removal of the tooth or teeth, causing less trauma than would be the case in establishing drainage any other way.

The exceptions to this would be in those cases in which a considerable amount of trauma was necessary in removing the tooth or teeth, such as impacted or unerupted teeth.

In presenting the next case I do so to explain the technic in administering the anesthetic.

A young woman, about 18 years of age, wished to have removed an enlarged frenum which had been previously removed but had returned, larger than before and assuming characteristics of an epulis. The growth had separated the central incisors one-eighth inch and extended from well up on the margin of the lip, also between the teeth posterior to the anterior palatine fissure. The usual procedure of induction was followed. As the nasal inhaler interfered with the proper performance of the operation in this case, it was used only until anesthesia had been well established. Then the gases were changed to the pharyngeal tube, and this tube was placed in the mouth, extending to the base of the tongue, well back in the pharynx. The sponges were packed in the mouth and the gases allowed to flow under sufficient pressure to maintain anesthesia. The field of operation was now unobstructed.

The next case, that of a child of 10 years, illustrates my methods of procedure with children. We make a special effort to eliminate any fright and fear, as an excitable patient does not respond readily to an anesthetic. While preparing the child for operation, our conversation regards football, basketball, snowballing, paper dolls or whatever the age and sex calls for. By this means, the patient's mind is taken from the present situation. This patient had the remains of ten deciduous teeth to be extracted. He had been to a dentist several times to have these removed but would never submit to the operation. He was a fine, vigorous, well built young athlete, and as soon as he was presented to me, I asked him what school he attended. I wagered that he was full back on one of the teams. His answer was "How did you know that?" Thus began an animated discussion during which time I had him seated in the chair, the assistant placing the towels around him. He questioned me to know what that thing was and I informed him it was a noseguard similar to a football noseguard. I then placed it over his nose, the gas having been turned on previously and told him to blow in it ten times, when it would whistle, and we would remove it. He made no objections, and, of course, before the ten inhalations were completed, he was unconscious, having at no time made any resistance. On discontinuance of the anesthetic, he awakened in a very few seconds, much surprised that his teeth had been removed. He assured us he would not be afraid to go to a dentist the next time.

As a rule children can be managed more successfully if the parents are not permitted to remain in the room. In explanation of the towels spoken of: when the child is placed in the chair, an old fashioned roller towel is placed

over his head confining the arms and hands. This may be done without creating any suspicion of your trying to restrain him. The operator should stand back and to the side of the chair, placing one of his legs through the towel as the inhaler is being applied. If the child should attempt to resist, the leg is pulled back, and the patient can neither slip down in the chair nor raise the hands to pull at the inhaler. Thus, he is quickly anesthetized without any disturbance. The instinct of life preservation is very tenacious, and any child will naturally attempt to defend itself. As a consequence, an operator should not be unnecessarily harsh with children.

When a dentist has developed his technic with nitrous oxid and oxygen in his own line of work, he will have calls from men of the medical profession to administer the anesthetic for them.

My time will not permit a full discussion of the methods used in administering nitrous oxid and oxygen for all classes of operations. I wish to explain briefly how best to administer it in certain operations in which difficulty is usually experienced in applying the anesthetic. For operations not about the head and neck, there is usually no interference in properly administering the gas, because the face inhaler may be used and all atmospheric air excluded. For all the following operations, it is necessary to employ a somewhat different technic, as the mouth or nose of the patient must not be obstructed. In cleft palate and harelip operations, the face inhaler is employed until complete surgical anesthesia is induced. The gases are then forced through the tubing, on the end of which is attached a mouth tube, which, when placed in the mouth of the patient, conveys the gases into the pharynx. If any difficulty is experienced in maintaining sufficient depth of anesthesia, the gases are allowed to pass through the ether to take up any amount thereof that may be necessary to control the patient properly. Usually, the ether may be dispensed with after the first ten or fifteen minutes. The administration of the anesthetic in this manner leaves the field of operation unobstructed and permits the maintenance of an even narcosis.

For the removal of tonsils and adenoids, the technic of administering nitrous oxid and oxygen is more difficult than in any other class of operations, for the reason that the patient's mouth must be kept open, and that, it being open, he naturally breathes through it, and the throat reflexes are among the last to be abolished. The respirations are apt to be interfered with by the accumulation of blood and mucous and by the jaw being opened too far by the manipulations of the operating surgeon. Nevertheless, nitrous oxid and oxygen may be administered in 95 per cent of these cases, and, by supplementing nitrous oxid with ether, all such cases can be successfully handled and a continued uninterrupted narcosis can be maintained until the completion of the operation without regard to the length of time consumed. The nasal inhaler is adjusted over the patient's nose and held in place by the elastic band passing around the head, but it is also necessary to hold the inhaler firmly with one hand. The patient is compelled to breathe through the nose, the mouth being held closed until anesthesia has been established. It is usually necessary to take from one to five minutes to

establish anesthesia. When profound anesthesia is obtained, the exhaling valve on the nasal inhaler should be closed so as to make a tightly fitting cap over the patient's nose. The mouth tube is placed in the corner of the patient's mouth at this time and the gases are allowed to pass through both the nasal inhaler and the mouth tube. The mouth gag is inserted at this time. The patient will now breathe through the mouth, and it therefore becomes necessary to allow the gases to flow more freely than they did during the induction of anesthesia. Sufficient volume of the gases may usually be forced through the mouth and throat of the patient to maintain narcosis indefinitely. There are a few cases, in adults especially, in which it is impossible to maintain a deep anesthesia with this method. It is then advisable to allow part of the gases to flow through the ether in order to take up any percentage that may be necessary to control the patient. When using ether with nitrous oxid, it is always to be remembered that oxygen should be used in sufficient amount entirely to prevent cyanosis or congestion.

### LIMITATIONS OF NITROUS OXID AND OXYGEN

In discussing the specific limitations of nitrous oxid oxygen, I wish to emphasize the fact that the subject is discussed in a broad sense, keeping in mind the possibilities of the administration of this anesthetic by persons not especially skilled in this form of anesthesia, using only nitrous oxid-oxygen and not supplementing it with ether.

The limitations of nitrous oxid-oxygen differ greatly in the hands of the expert, and to the average anesthetist probably the greatest limitations of this agent is the difficulty experienced on the part of the anesthetist in mastering and executing the fundamental principles involved. In the hands of other than an expert, I consider nitrous oxid-oxygen to be contraindicated for any operation in children under 5 years of age. The reasons for this are that young children are easily asphyxiated; that they are easily thrown into epileptiform twitching of the body, and that they pass from light to profound anesthesia in a remarkably short time. It is, therefore, very difficult to administer nitrous oxid and oxygen to young children successfully. This agent is also contraindicated in old people in whom the degenerative processes of the body are manifested, especially when an extensive degree of arteriosclerosis is present. The reason for excluding this class of cases is the likelihood of a certain amount of asphyxia accompanying the anesthesia. In the aged, if a nonasphyxial form of anesthesia can be secured throughout, nitrous oxid and oxygen is without question the best anesthetic to be employed. Some of my most gratifying cases have been in old people and I have had no bad results with this class of patients. I have always maintained a nonasphyxial narcosis, not hesitating to use some ether if necessary.

If a major surgical operation is to be performed, it would be unwise to attempt to anesthetize with nitrous oxid and oxygen a strong, vigorous, rough man whose habits include an excessive use of tobacco and liquor, unless the anesthetist had become thoroughly proficient in the handling of this anesthetic agent. Unless the desired depth of anesthesia can be obtained in a given case without a marked degree of asphyxia, it is much safer to use more

oxygen and a little less nitrous oxid, and to add enough ether to secure the desired amount of relaxation. This applies principally in major surgical operations. A slight degree of cyanosis is not objectionable, nor is it dangerous, and if less than 11 per cent of oxygen be used with nitrous oxid, more or less cyanosis will be manifested. A slight degree of cyanosis is the rule with this form of anesthesia unless a large dose of preanesthetic narcotic is given or some ether is administered with the gas. The percentage of ether given with the gases should be known as far as this is possible.

The ideal patients for nitrous oxid-oxygen anesthesia are the very ill, the anemic, the debilitated and those possessing low vitality from any cause; in short, all except those requiring a powerful anesthetic agent. The great majority of cases may be handled safely and successfully if the nitrous oxid and oxygen is administered by one skilled in its administration.

I wish to emphasize the importance of proper facilities for the care of the patients following the anesthetic and operation. When one is doing all operative work, either under a general or a local anesthetic, there must be facilities provided so that the patient may fully recover from the effects of the anesthetic in comfort.

I have found that patients may be moved immediately on regaining consciousness with less likelihood of causing nausea than would be the case a few minutes later. They are therefore taken to the recovery room and required to lie down for at least ten minutes, after which time the vast majority may leave the office without any occurrence of dizziness or nausea. In prolonged cases, a longer time should be allowed for complete recovery.

Every office in which oral surgery or extraction of teeth is done should have a recovery room or rooms, and I consider it almost bordering on malpractice to allow a patient to leave the office immediately after an anesthetic has been administered. Any one who does this is certainly not giving his patients the care they are entitled to and should expect.

One specializing in extraction and oral surgery should have two or three rest rooms for each operator, and these rest rooms should give privacy to the patient and at least one friend. The rooms should be well ventilated and should contain a comfortable couch or bed, at least one chair, a cuspidor or pus basin, a plentiful supply of towels and a warm mouthwash. The nurse should show an interest by frequently inquiring if there is anything more that she can do, and the dentist should see that everything is all right before the patient is permitted to leave. This is the care that private patients expect and are entitled to in all hospitals and it should be carried out just as faithfully if this surgical work is being done in an office, as most of it is now being done.

# THE DENTAL EDUCATIONAL COUNCIL AND THE COLLEGES*

By F. R. HENSHAW, D.D.S., F.A.C.D., Indianapolis, Indiana

IN order that the title of this paper may be properly understood, it is necessary that a brief survey of dental education in America be made.

Beginning with the first organized effort at dental teaching in 1839, and the unfortunate and regrettable failure of medicine to accept the dental profession as a part and parcel of the healing art at that crucial period, we find a sincere and devoted group of men of the highest order of intelligence and professional ardor, devoting themselves to the advancement of their chosen profession in the schools and colleges, in spite of the indifference, opposition and oftentimes actual antagonism of the medical schools and other constituted sources of education.

Because of this condition, without endowment, without support from the state and without an informed public, there grew up in America a great number of dental schools that were privately owned, either by groups of dentists or by individuals.

Nothing could be more natural than that, in course of time, these schools should become the property of individuals and, by the very simple rules of economics, be expected to provide a profit to their owners. In the early years of the development of dentistry, many schools were organized, most of them on the high plane of service to mankind, and if some failed to live up to the proper standards, it was but natural, considering the difficulties that continually beset them. For the most part, these privately owned institutions kept pace with the advancement of thought and program and rendered a splendid service, and, over a long period of years, ranked as well as or even better than some of the university schools, which were having their own troubles through starvation for lack of funds and because of neglect in favor of medicine.

Many of the greatest names in the history of dentistry are of those whose whole careers were associated with the independent and unsupported schools, and they are the men whose vision and determination finally brought about the changes that have resulted in the present program, which has been unanimously adopted by the dental schools of America.

The Dental Educational Council was the outgrowth of the realization that all was not well with dental education and that something must be done to elevate it to a higher plane and to systematize and direct its activities. During the early years of its organization, it had been deemed quite suffi-

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cient that dentistry be taught as a mechanical art, rather dimly associated with public health and public service and the correlated sciences.

The developments of the decades between 1890 and 1910 had clearly demonstrated that such a position was no longer tenable, and in searching for a solution, it was but natural that the three great bodies having to deal with the subject should join in a concerted effort. The National Association of Dental Examiners, the National Dental Association and the National Association of Dental Faculties, by the appointment of five members from each group, founded the Dental Educational Council, whose object was to make a study of dental education and propose ways and means for its betterment.

This body, being composed of men who had devoted their lives to dentistry, was not expected to function in a radical and iconoclastic manner, and it can be truly said that it has lived up to the expectations of the profession in a most remarkable way.

With few exceptions, the personnel of the Council has been made up of men of fairness, judgment, discretion and ability, and the radicals have had little voice in its deliberations. Mistakes have been made, but they have always been tempered with judgment and desire for the right. Fundamentally, the work of the Council has been sound.

In the beginning of the activities of the Dental Educational Council, it was obvious that a survey and analysis of the curriculums of the various colleges was necessary if any approach to a uniformity of teaching and requirement was to be had. Accordingly, such a survey was made, with the cooperation of all the schools and the national bodies, involving several years of painstaking study and thoughtful weighing of values. Had it not been near tragic, it would have been laughable to observe the wide discrepancies and differences that existed in the curriculums of the best as well as of the poorest of the schools.

Subjects that were given many hours in one school were either ignored or given small place in another; systems of records were found imperfect or neglected; methods of teaching failed to meet the requirements of sound pedagogy; equipment and other teaching facilities were found inadequate; properly trained teachers were lacking.

All this was patently apparent to every one concerned in the matter of dental education, and out of it grew the "Course of Study and Curriculum" as suggested and advocated by the Council, and which has served as great a purpose as any one factor in the whole course of dental educational advancement, by bringing about an equitable uniformity in standards and methods.

The evils of acceptance for enrollment in dental schools of those with insufficient or improper preparation has also been eradicated, and by the general adoption of the ruling that, beginning in 1926, all dental schools shall require a predental, academic year for admission, a definite basis for advancement in cultural education has been established.

While there has been much divergence of opinion as to the best means for the addition of cultural courses to the dental curriculum, there has been little or none as to the value and necessity of scientific and, so-called, medico-dental subjects, and by virtue of the present plan of procedure, dentistry is now nearer than ever before to a just

recognition as an integral and necessary part of the health service of the world.

The medical profession, discerning the correlation of dental and general pathology and the interdependence of oral and general hygiene, has assumed a more liberal attitude toward dentistry and has begun to exhibit an interest in the dental program, quite different from that formerly existing. In many of the universities having both medical and dental departments, members of the dental faculty are appointed to the hospital staffs and are accepted on an equal footing with the medical members. Exchange of teachers is the rule, and department heads serve for both branches.

Dental interns are selected for the hospitals and are placed on an identical basis with medical interns. School and charity clinics, operated either by the universities or by the public health services, are equipped for dental service and are manned by graduate interns from the dental schools.

In Indiana, and also in other states, a number of the state institutions for the deaf and dumb, the blind and the insane, and also some of the penal institutions, are provided with dental service, with full-time graduate dental interns, serving on the same basis as the medical men. The state assumes an equivalent value for the two services.

The tremendous flood of information concerning the need for dental service has begun to permeate the lay mind, and a better understanding of the processes of dental education is in progress. This must inevitably bring about a stimulation of interest in the character and training of the dental practitioner, and therefore a just appreciation of his work and the educational forces back of him.

Another tremendous factor in the work of the Dental Educational Council and the colleges has been the survey of dental education made by the Carnegie Foundation, which has been carried out in cooperation with the Council. Complete and careful analyses of the problems of dental teaching are contained in the assembled findings of the report of William J. Gies, director of the survey, and it may be confidently expected that a great advance in the work of the schools will follow.

Unanimous agreement on any given problem could not be expected, nor would it be wise, but from the careful study of all known factors and tenable theories will come the revision and adjustment of program for the greatest good to the profession and the public.

However unpleasant may have been some of the findings and conclusions, and however many the mistakes that may be chargeable to the Council, an honest review of its activities and work for the past ten years must compel the dental profession, and those having to do directly with dental education, in particular, to congratulate the Council on its labors and to predict a maximum of good as the net result of the combined efforts of all concerned in the program of dental education, including the schools, the Council, the association, the Carnegie Foundation and the profession at large, to the end that the ultimate beneficiary, the public, may come into its own.

# THE USE OF CAST GOLD INLAYS AS BRIDGE ABUTMENTS*

By R. H. VOLLAND, M.Di., D.D.S., M.D., F.A.C.D., Iowa City, Iowa

GOLD inlays have been used in bridgework, with varying degrees of satisfaction, for some time. The advent of the cast inlay caused a rapid increase in the use of the inlay in this type of work. It is not difficult to understand that the wave of enthusiasm for the use of inlays as bridge abutments grew when the objectionable features of the various types of bridge abutments then in use are recalled. It is also easy to understand how this early enthusiasm led operators to use inlays in cases that were entirely unsuited for such forms of anchorage. Coupled to this indiscriminate use of inlays was the lack of knowledge of two prime requisites: first, suitable cavity preparation; and, second, what might be expected of an inlay as an anchorage even in properly prepared cavities. Consequently, many failures resulted, and the inlay as a bridge anchorage fell into general disrepute; but, through the efforts of persistent and thoughtful operators, these vital factors have been tested by clinical experience, and, gradually, the inlay has attained a definite place in certain types of bridgework. While this use of the inlay is increasing as a result of such thought and perseverance on the part of the operators, it can never completely replace other types of anchorages and abutments because of inherent limitations in the inlay process and its application. In suitable cases, the inlay is the most logical and desirable type of anchorage.

This discussion will be confined to a consideration of the fixed but nonrigid type of bridge. In the earlier attempts to use inlays as abutments, it was customary to solder both inlays to the suspended portion of the bridge. Such bridges are almost invariably predestined to failure. The variation in amount and direction of movement of the pier teeth subjected such anchorage to decided leverages and unusual strains. Such leverages are increased many fold in the longer bridges. Even with the most carefully planned and perfectly executed cavity, it is impossible to provide invariably against these disturbing elements. In cases in which the two post inlays in pulpless teeth were soldered to the span, a slightly larger percentage of successes resulted than when two strictly cavity type inlays were used; yet this percentage is not satisfactory. So the usual final result of this method is a repeated loosening of one or both anchor inlays, or a fracture of one of the pier teeth.

To provide against such contingencies, the so-called "principle of breaking stress" is applied. This permits un-

*Read before the Section on Partial Denture Prosthesis (Including Crown and Bridge Work) at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

hampered movement of the pier teeth without causing leverages and strains that cannot be successfully dealt with in cavity preparation without endangering the crown or root of the pier teeth. Thus, two functions devolve on the inlays in this type of bridge; namely, anchorage and support.

The cavity preparation for these inlays must be carefully planned and perfectly executed. Such cavities of cavity is not desirable. The more closely a cavity approaches the perfect box type, the greater the mechanical and frictional retention of the inlay after it is cemented. Therefore, broadly extensive cutting is not necessary. In ordinary cases, ordinary extention is all that is necessary. It is often a sane, precautionary measure to prepare these cavities slightly deeper than would be done for simply inlay

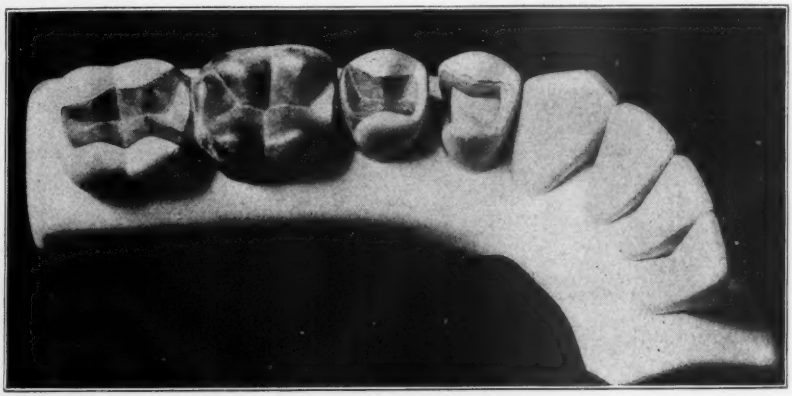

Fig. 1.—Bridge supplying first molar.

follow the general rules of extention for prevention, resistance form, retention form, etc., as expounded by G. V. Black. Maximum resistance and sufficient retention must be provided, and, at the same time, general strength of the pier teeth must be conserved. Resistance form is provided by cutting flat seats at right angles to the direction of stress normally coming on the completed inlay; which usually means at right angles to the long axis of the tooth. The surrounding walls are prepared so they meet these seats at an angle that is just slightly greater than a right angle. A pronounced hopper type restorations. This provides more resistance and retention, but it is never necessary to cut so deeply that the pulp is endangered. Aside from the possibility of endangering the pulp, broad and deep preparations weaken the tooth.

Retention is provided by the use of dovetails, pins and posts. In the use of the dovetail form of retention, it is not necessary to make an exaggerated type. Pronounced dovetails multiply the difficulties of providing a satisfactory inlay without increasing proportionally the resistance and retention. The use of pins and posts is advantageous

under certain conditions, but their field of value is limited.

The walls of the cavity must be made flat and smooth in the direction of the outlet of the cavity. The internal angles of the cavity should be definite and clear cut. The cavosurface angle must be properly beveled; unsupported enamel rods must be removed, and protection against pulverization of the enamel margin by occlusion must be provided. Since wax will cover this bevel, it may be necessary to modify it in certain locations so that there will be no danger of distorting the wax when the pattern is withdrawn.

It is not necessary to provide as much resistance and retention in the cavity that is to receive the support inlay as in the one that is to receive the anchor inlay. In short, a standard inlay cavity has proved satisfactory for the support inlay.

In a broken stress bridge, it is not necessary to provide exact parallelism of the direction of insertion of both inlays. The movement between the two parts of such a bridge will permit the seating of the inlays even when the parallelism is necessarily faulty. In the majority of cases, a fair parallelism is easily obtained and is desirable.

Stress is broken by one of two methods. In the one, a short lug, from 1 to 2 mm. long, and approximately the size of a 14 or 16 gage wire, extends from the pontic and rests in a similar sized groove that has been prepared in the supporting inlay. In the other, a pin of clasp metal or iridioplatinum wire, from 14 to 16 gage, 2 or 3 mm. in length, extends out of the pontic to rest in a hole or socket that has been made in the supporting inlay at a suitable location. Free movement should be provided in each of these devices. The lug should taper away from the pontic slightly and the gingival aspects should be rounded laterally. The opposite surface of the lug may be made to conform to the contour of the inlay at that location, if desired. This lug may be made by shaping a suitable piece of wire or it may be cast as a part of the pontic. The pin should be slightly tapered, except on the bearing surface, and should not fit the opening of the socket too closely. Such shaping of these two forms of support provides free, independent movement of the bridge piers and minimizes the strain and leverage on both inlays.

**Fig. 2.—Bridge shown in Figure 1 dissembled.**

There are a few general rules and considerations attending the use of a nonrigid bridge that may be discussed with profit. This type of bridge is

applicable to cases requiring the replacement of one tooth. In these cases, the leverage and possible dislodging forces are at the minimum, and therefore the question of anchorage is simplified. This type of bridge has been used successfully in selected cases in which more than one pontic was necessary, but all conditions must be auspicious, and the planning and construction must be faultlessly done, if satisfaction is to result.

Fig. 3.—Lug and groove type.

The crowns of the pier tooth must possess a sufficient amount of strong tooth substance to permit the preparation of a cavity with adequate resistance and retention form. Therefore, the absence of defects, both mechanical and pathologic, in the tooth structure is a favorable factor. The element of brittleness in pulpless teeth must be taken into consideration when considering such teeth for bridge piers.

The arrangement and occlusion of the teeth must be carefully studied. This study should not be confined to the few teeth that are intimately concerned in the bridge operation, but should extend to the whole complement of teeth. An irregularity in arrangement and occlusion does not preclude the use of an inlay as an abutment, provided a cavity can be prepared that will safely absorb the strains and tolerate the leverages that will be spent on the restoration. Even after the closest attention has been given to this phase in the manufacture of the bridge, the occlusion should be carefully checked and corrected after the bridge has been cemented to position. A subsequent inspection is desirable. This attention is not only a safeguard for the bridge, but is also a precautionary measure in maintaining the health of the tissues investing the roots of the teeth concerned.

The condition of the peridental membrane and tissues overlying roots

of the pier teeth is of prime importance in deciding the feasibility of using a bridge. Any deviation from the normal must be weighed and considered. While there is no particular mutual support between the piers in a nonrigid fixed bridge, as there is in the rigid type of construction, some degree of peridental involvement does not contraindicate a broken stress bridge. This is especially true if propitious occlusion can be attained. The loss of alveolar process is always a discouraging discovery, and especially so if accompanied by considerable movement of the tooth. It is impossible to state, in a hard and fast rule, the degree of peridental involvement that contraindicates a broken stress bridge. The operator's experience and good judgment are the guides that must be followed in these cases.

Since it has already been inferred that the inlay does not have universal application as a bridge abutment, the indications for its use cannot be set forth in a set of fixed rules. Consequently, no attempt will be made to present a formal classification of these bridges as I have been unable to devise a concise classification that has any particular working value. Perhaps an understanding of the indications for such bridges can best be arrived at through a description of rather definite cases in which the rules and principles are clearly exemplified.

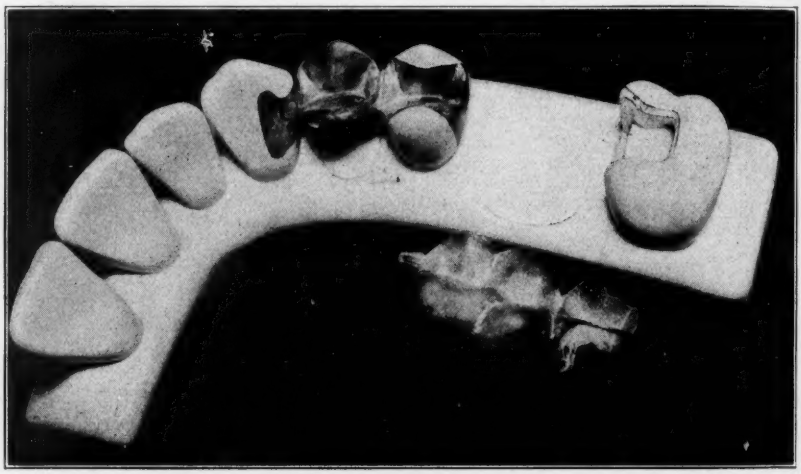

Fig. 4.—Molar bridge.

The type of construction used to supply one molar or bicuspid is very simple, and the two types are similar. A bridge supplying the lower first molar is shown in Figure 1. A dissemblement of this bridge is illustrated in Figure 2. The type of cavity preparation necessary for the anchorage inlay is clearly shown. The rest in this case is provided by the use of the pin and socket form. The socket is located in the distal surface of the distoclusal inlay

in the bicuspid at or near the location of the original tooth contact point. Instead of using the pin and socket type of rest, the lug and groove type, as illustrated in Figure 3, may be employed. In determining which type of rest shall be used in these short bridges, the thickness and prominence of the contour of the rest inlay will usually be the guide. The inlay must be at least 2 or 3 mm. thick if the pin and socket rest is to be used. In many cases, cavities might be prepared that will meet all the other requirements of a rest inlay without providing for sufficient thickness of the inlay. In such cases, the lug and groove rest is indicated. Figure 3 also shows the details of supplying a lower second bicuspid.

In supplying upper molars and bicuspids, the same type of bridge can be employed. A molar bridge is shown in Figure 4. Some operators contend that the pin and socket type of rest should always be used on bridges in the upper arch because the lug and groove may permit a bridge to tip down when at rest, and to click or chatter when in use. This may be a wise measure, but the condition of the peridental membrane and of the occlusion will largely solve this problem of selection.

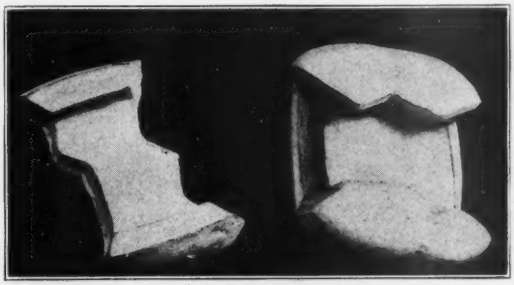

Fig. 5.—Mesioclusodistal restoration.

While a well adapted inlay in a carefully prepared proximoclusal cavity in a molar gives sufficient anchorage for most of those one-pontic bridges, the condition of the tooth—the presence of caries, inlays and fillings, contact points, etc.—may make it advisable to use a mesioclusodistal restoration (Figs. 5 and 6), and, in some cases, it may even be advisable to provide this additional anchorage regardless of the condition of the tooth. The use of a mesioclusodistal restoration for a rest inlay is usually governed solely by the condition of the tooth.

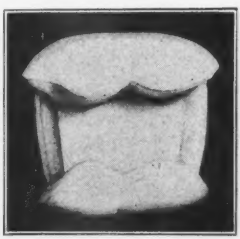

Fig. 6.—Mesioclusodistal restoration.

In supplying an upper or lower first bicuspid, a mesioclusodistal restoration in the second bicuspid is usually employed as an anchorage. (Fig. 7.)

In large, strong second bicuspids, a mesioclusal inlay can be depended on in many cases.

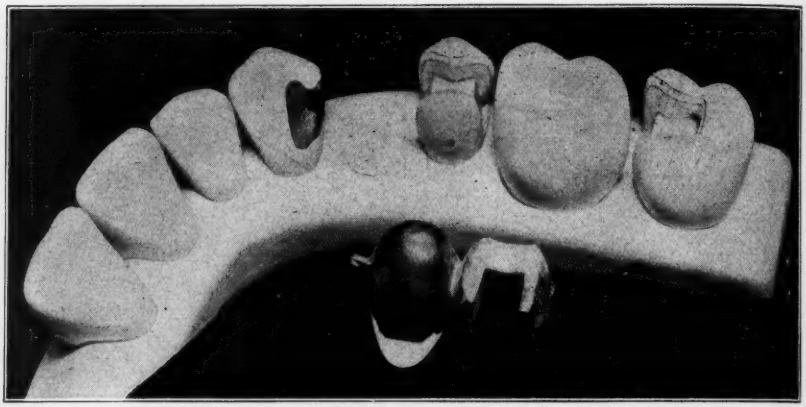

Fig. 7.—Mesioclusodistal restoration in second bicuspid employed as anchorage in supplying first bicuspid.

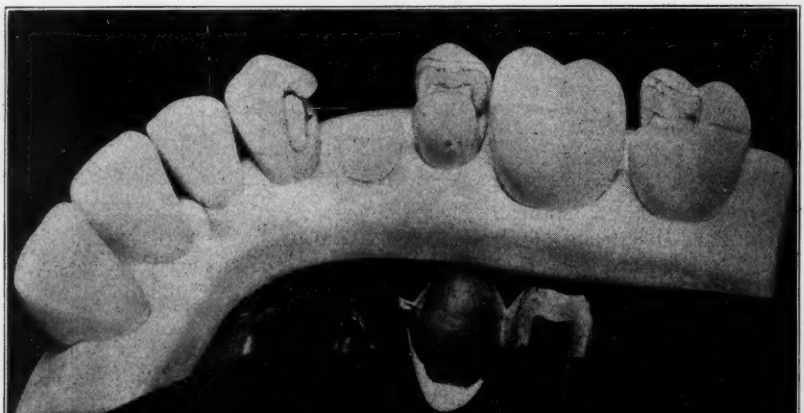

Fig. 8.—Rest used in simple proximal inlay in cuspid.

One of the two forms of rests may be used in a simple proximal inlay in the cuspid. (Fig. 8.) If the lug and the groove, a definite rest is provided, with little tendency for the lug to slip out when the bridge is brought into

groove type is to be used, it is well to sink the groove into the inlay in a labiogingival direction. By so fashioning

service. This direction of the groove also facilitates the seating of the bridge when fitting it in or cementing it in position. Conditions that make it advisable to use some other form of rest inlay in the cuspid may prevail. The lingual dovetail (Fig. 9) or the step-type usually meets these requirements. In supplying the lower first bicuspid, if the occlusion is normal, it is advisable to prepare the proximal cavity so that the inlay is inserted from the labial side. The reasons are obvious.

Fig. 9.—Lingual dovetail type of rest inlay.

In carefully selected cases, the two bicuspids or the first molar and second bicuspid can be supplied by this type of bridge. The arrangement and occlusion of the teeth must be favorable. It is imperative that the pin and socket type of rest be used in these longer bridges, lest they sag when at rest or chatter when in use. Special attention must be given to provide adequate retention for the inlays. Mesioclusodistal inlays are strongly indicated for anchorages.

In supplying scattered teeth, many successful combinations can be worked out. Figure 4 shows a combination of two of these bridges. While the cut depicts the lug and groove rests, the pin and socket type may be used just as successfully.

The field of usefulness of inlays in bridgework for the anterior teeth is limited. This is necessarily so because of the difficulty of preparing cavities of sufficient resistance and retention form in these wedge-shaped teeth without dangerously weakening the tooth and endangering the pulp. So, the three-quarter crown or some closely related type of anchorage is preferable.

If inlays are to be used in anterior teeth for anchorage, one pontic is all that can be carried, and the cases must be carefully selected. The types of cavities that lend themselves to anchor

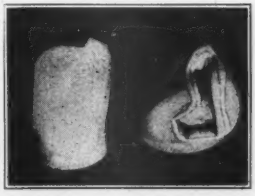

Fig. 10.—Lingual dovetail type of inlay, proximo-incisal restoration.

inlays in this form of bridge are the lingual dovetail and the mesio-incisodistal. It is practically never advisable to use the lateral incisor as a pier tooth to carry the anchorage inlay. In well-formed, strong central incisors and cuspids, the lingual dovetail type of inlay (Figs. 10 and 11) can be utilized to carry a lateral incisor pontic, if other conditions are favorable.

Fig. 11.—Lingual dovetail type of inlay, proximal restoration.

It is preferable to locate this type of anchorage in the cuspid when all other conditions are favorable. The mesio-incisodistal restoration (Fig. 12) provides more resistance and retention, but the necessary display of gold is objectionable. The additional anchorage gained by using a mesio-incisodistal restoration is not sufficient to warrant the attaching of more than one pontic,

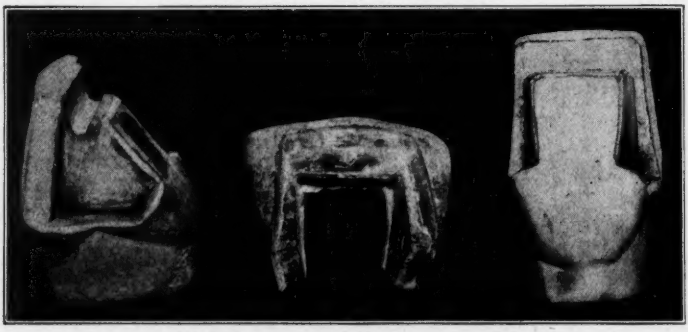

Fig. 12.—Mesio-incisodistal restoration.

and that usually confined to the lateral incisor. In particularly favorable cases, a lingual dovetail, or a mesio-incisodistal inlay, in a strong well-formed

central incisor, can be depended on to support satisfactorily a pontic for the adjacent central incisor.

All these bridges must have a rest, and the selection of a type to be used will be governed by the conditions found in the particular case. Proximal inlays (Fig. 13 ) and proximo-incisal restorations (Figs. 10 and 11) will serve the purpose.

Rest inlays, in combination with crown anchorage, are often of great advantage and very desirable. However, the success attained in using inlays as bridge abutments depends largely on the good judgment and skill of the operator.

Fig. 13.—Proximal inlays.

DISCUSSION

*J. V. Conzett, Dubuque, Iowa:* This paper is timely and is well-suited to help solve the problems that have arisen as a result of the use of the cast gold inlay as an abutment for bridges; for, since it has been used, many failures have resulted, and many good teeth have been lost as a result of improper use of it. But even though this has been the case, there is a place, and a large place, for the gold inlay in the anchoring of bridges. They are desirable for the reason that they can be used without the sacrifice of the tooth tissue that is necessary in the crown, and they have a greater esthetic value than the crown, band or the three-quarter crown, because of the ability to hide the display of gold occasioned in the use of the other abutments. Therefore, it is a work of efficiency and esthetics to develop a method of using the gold inlay for bridge abutments that is safe, and Dr. Volland is to be congratulated on presenting a paper that shows the reasons for the failures of the past, and offers a method in which those failures can be prevented. As he has pointed out, the great factor in the making of a bridge using the inlay as an abutment is the breaking of the stress, by making the bridge in two parts that are joined together in the mouth in such a way that they prevent the displacement of the bridge without applying undue stress on the abutments. It is almost impossible to make a bridge with inlays as abutments that are rigidly attached to the bridge, a bridge having normal occlusion and one that will not work loose in a short time, with the loss of the bridge and, frequently, the loss of the abutment tooth by reason of decay, which progresses with extreme rapidity under a loose abutment. This, as Dr. Volland has explained, is due to the movement of the individual teeth, and the stress of the movement loosens one of the inlays because they have not sufficient retention to stand stress as a crown of the shell or dowel type. If, on the contrary, the bridge is made in two parts, using the pin and groove or pin and socket, as

may be indicated, the stress of the movement of the teeth in their sockets is not conducted to the other abutment, and, consequently, there is no movement stress and the abutments maintain themselves in their respective cavities with much more certainty. But, as Dr. Volland has pointed out, there must be a sufficient degree of resistance and retentive form given to the cavities that are to carry the abutment inlays, to insure enough mechanical and frictional resistance to carry the load imposed on them. To that end, the preparation of the cavity must be on scientific lines. The seats must be flat and the walls as nearly parallel as it is possible to make them and have the inlays seat in the cavity; for the nearer we approach the box form in making our inlay cavities, the greater will be the retention, and as we depart from that form, we will proportionately weaken the retention of the inlay. Frequently, it will be found advisable to use some form of hard gold for the anchor abutments to prevent a stretching and bending of the inlay under stress, which is a frequent cause of failure when a soft gold is used in the casting.

# A CONSIDERATION OF SOME IMPORTANT FACTORS IN PARTIAL DENTURE PROSTHESIS*

By N. B. NESBETT, D.M.D., Boston, Massachusetts

IF the general purpose of a partial denture may be described as that of restoring and preserving function, it is evidently important for it to be so devised that the original position and occlusal relationship of all the anchor teeth will be preserved.

The growing recognition of this, and of the dangers that lurk in many an otherwise plausible method of partial denture procedure, has led to a curious misapplication of a well-known term. If the partial denture is so unfortunately designed and constructed as to loosen and move the anchor teeth, it is frequently described as an "orthodontia" appliance, and its action as an "orthodontic" action. The term is an unhappy one, of course, for the reason that an orthodontia appliance is one that is deliberately designed to effect the movement of teeth. Consequently, it betrays distinctly loose thinking to employ the same term for a beneficient procedure that is carefully planned that we would employ to condemn an effect inadvertently produced by another type of appliance.

The expression, nevertheless, has its value. It sounds an ominous note of warning to the careless and unthinking prosthetist. It will serve our present purpose by drawing attention to some of the principles of orthodontia that have a bearing on partial denture design and construction, and it may, perhaps, induce dental study clubs to try the experiment of inviting orthodontists to review the methods at present employed in partial denture prosthesis.

The purpose of an orthodontic appliance may be defined as that of moving teeth from their original and abnormal alinement and occlusal relationship, into better alinement and occlusal relationship.

*Read before the Section on Partial Denture Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

Among the first things to be noted is that little force is required for the initial movement of teeth. When orthodontists desire to move teeth, they use wires of very small gage, with a consequent gentle but steady pressure applied to the teeth to be moved.

Another thing to be noted is that, while this pressure may be slight, tooth movement, when once started, may be progressive and considerable.

Still another fact familiar to orthodontists is that the movement effected is not necessarily confined to the particular teeth to which the pressure is directly applied. Through contacts with adjacent teeth, the same slight pressure that moves one is sufficient to change the position of a group.

Finally, all orthodontists recognize the tremendous power of occlusion; the fact that, when once the original occlusal relationship has been disturbed, the inclination of the planes of opposing teeth aids tremendously in accelerating the movements that they desire to produce.

The application of these principles to partial denture prosthesis is highly significant. A comparatively small error in denture construction can produce considerable pressure on an anchor tooth, and when once this pressure is applied, all the other factors come into play. The movement is not confined to that tooth alone. The force is transmitted to adjacent teeth with which that tooth may be in contact. The same forces of occlusion are at work, as soon as the original occlusal relationship, or balance, has been disturbed. When once the process of tooth movement has begun, the end result of a badly designed or constructed partial denture is nothing less than complete distortion of the whole arch.

The actual movement of teeth is not the only injury, nor is it the most serious injury produced by "orthodontic" partial dentures. The most serious factor is the injury done to the pericementum of each tooth to which this so-called orthodontic pressure is applied. This injury may even occur when the denture is so constructed that the actual movement of the anchor teeth is circumscribed. And when once this injury has been inflicted in adult cases, it can seldom, if ever, be arrested, and leads therefore to the ultimate exfoliation of the affected teeth. This is a factor that does not trouble the orthodontist. He moves teeth in a physiologic manner. His operations are carefully controlled. His appliances are delicate and are devised to produce known effects. He is in constant touch with his patients, who are all young and possess a high tissue regenerative power.

On the other hand, the partial denture that is an "orthodontic" appliance is not so through design. The effects it produces are not anticipated. The dentist is not in constant touch with his patient, and generally only becomes aware of the damage after it has gone so far that remedy is hopeless. Moreover, patients who wear partial dentures are usually of an age at which their tissue regenerative power has ceased to function.

The "orthodontic" action of a partial denture may be due to the forces exerted on the anchor teeth by the parts of the clasps themselves, or it may be due to the forces exerted through the clasps by the structure of the denture itself.

The forces exerted by the parts of clasps are a source of injury that is not generally understood, perhaps because an effort has seldom been made to analyze the structure of a clasp and to consider the mechanical relation of its parts. The parts to be considered are (a) the occlusal rest, and (b) the clasp arms. The use of an occlusal rest is obviously necessary in appliances that must depend on the anchor teeth alone for support, because of the small mucosa area available for saddle support. This should be axiomatic, yet how often are appliances of this type observed in which no provision has been made for occlusal rests, and in which the force of mastication has driven a small saddle into the alveolar process, tearing the pericementum from the anchor teeth and wedging them apart. This last consideration brings us to the principal reason for using occlusal rests even when the denture is almost entirely a tissue-borne structure. In these cases, the occlusal rests not only permit a rough division of the burden of supporting the structure between the alveolar ridges and the anchor teeth, but also protect the soft tissue areas immediately adjacent to the anchor teeth, including, of course, the pericementum, from injury due to the settling of the denture. If the denture settles, it is an unfortunate circumstance if the posterior edge of the saddle does press deeply into the alveolar ridge. That in itself is not nearly so serious a condition as if the clasp arms, and the anterior part of the saddle, strip the pericementum and cause the loss of the anchor teeth. Occlusal rests are generally desirable in tissue-borne appliances for two other reasons. In the first place, without them, the retentive power of the clasps may be considerably impaired. More important than this is the part they play in rebasing. Without occlusal rests, an important check or guide stop is lost for the process of taking the impression for rebasing the denture. Granting the general necessity of occlusal rests, whether or not the appliance is supported entirely by the anchor teeth, it is obviously important for them to be constructed so as to function properly. To insure this, it is absolutely essential for them to be seated in shallow sloping grooves stoned into the marginal ridges of the anchor teeth. This preparation is required to give the occlusal rest the strength of the tapered form, wide and thick at the point of juncture with the body of the clasp, the point at which the strain on it is greatest. Without it, the occlusal rest is inevitably weakened by the projection into the metal of the angular marginal ridge. It may also be remarked, in this connection, that the rectangular slot sometimes suggested as a seat for the rest is distinctly ill advised. It is impossible to give the rest so shaped the same degree of strength as the tapered form derived from a sloping groove without cutting deeply into the enamel. This fact has evidently been recognized by many, as they find it necessary to obtain sufficient depth for their square seated lugs or rests by resorting to inlays.

There is an intimate relationship between the form of the occlusal rests, or the manner in which they are seated against the anchor teeth, and the design and construction of the arms of the clasps; a relationship that has been largely ignored. The clasp arms must engage each anchor tooth on the proximal surface opposite to that against which the occlusal rest is seated, so as

to brace the tooth against "orthodontic" action. Otherwise, the teeth will be moved by the forces of occlusion working through the inclined planes of the seats in which the occlusal rests are placed. It is not sufficient to employ one clasp arm alone for this purpose unless rotation of the anchor tooth is desired. The clasp arms, moreover, must not only be designed to brace the tooth against "orthodontic" action, but also must be constructed of a clasp metal possessing the physical properties necessary to resist the forces to which they are subject. If the clasp metal used is soft or pliable, it is evident that the clasp arms will be entirely ineffective as braces against these "orthodontic" forces. Further, they may even be spread by the repeated flexures that occur when the denture is seated and removed, and aside from the fact that the clasps would lose their efficiency as braces against "orthodontic" forces, they would also lose their efficiency as retaining devices. Yet, besides being elastic enough to resist deformation, the proper material for clasps must have what physicists term a high "life value." Some clasp metals are fairly elastic until subject to repeated stresses, when fatigue gradually asserts itself, with the results that one or both clasp arms fracture.

Returning again to the seat for the occlusal rest, and the relationship it bears to the arms of the clasp, the groove must be stoned into the marginal ridge at the proper angle. This angle should be approximately one of 45 degrees to the long axis of the anchor tooth. If it is more than 45 degrees, the forces of occlusion will tend to tip the tooth toward the clasp. Furthermore, an occlusal rest made to conform to such a groove would not have sufficient strength, and would be liable to bend or break at the point of juncture with the body of the clasp, this, in turn, tending to deform or fracture the clasp arms.

If the angle is less than 45 degrees, the tooth is liable to be wedged away from the clasp, and sufficient force again may be brought to bear upon the clasp arms to deform or fracture them.

A not uncommon error in clasp design is exemplified by what may be termed a "one arm" clasp. This type of clasp, as well as one with arms that are too short is distinctly an "orthodontic" device. Through lateral movements of the mandible, the forces of occlusion bring a constantly recurring pressure to bear on one surface of the anchor tooth, causing it to move in the opposite direction. Clasps, therefore, must engage opposite surfaces of each tooth, in order to resist this force in either direction. This factor, it may be mentioned, was pointed out several years ago by Dr. F. E. Roach, who employed the term "reciprocal action" to define this relationship between the arms of a clasp.

Although occlusion is the most important single factor in dental restoration, its neglect is not peculiar to partial denture prosthesis, and therefore will not be considered at this time. Aside from the errors arising from faulty clasp design and construction, we are confronted with the following sources of error: (1) failure to distinguish clearly between tooth and tissue support; (2) failure to study the conditions necessary for sound tooth anchorage; (3) failure to provide sufficient tissue coverage and support when tissue support is necessary, and (4) failure to

maintain the proper relationship between the parts of a denture, particularly between the clasps. These errors tend to convert what is designed to be a dental restoration into what we have termed an "orthodontic" appliance. Inadequate tissue coverage and support, moreover, produce other effects on the alveolar process and occlusal relationship—effects that are disastrous and far-reaching even if they cannot be strictly described as "orthodontic."

A fundamental principle that must be understood if restorative procedure is to be more than a matter of chance is the difference between a denture supported by the teeth and a denture supported by the tissues. A tooth-borne appliance, commonly termed a removable bridge, may be *retained* by clasps, but the clasps must be equipped with occlusal rests, so that it may be supported as well as retained by the anchor teeth, in order to resist the impacts of mastication.

A tissue supported denture is an appliance that is partly, if not wholly, supported by the alveolar ridge, by means of a saddle, or saddles, in opposition with the mucosa. The clasps may or may not be equipped with occlusal rests. If they are so equipped, the load may be divided between the teeth and the alveolar ridge, provided the proper technic for its construction is carried out.

The first thing to be considered in planning a tooth supported appliance or removable bridge is whether the anchor teeth are sound enough to carry their load. The next thing is the direction in which the force of occlusion will be transmitted to them by the occlusal rests. If an appliance is supported at one end by means of an occlusal rest on a tooth that is sound, but the support at the other end is insufficient, the sound tooth will be exposed to a type of strain known as torque. This is a strain that causes the sound tooth to be loosened and separated from the tooth adjacent to it, so that the latter also is menaced by the space created when contact has been lost.

In the construction of partial dentures that are supported by the alveolar process, it is a common error to use narrow saddles that sink into the compressible mucosa every time that biting stress is applied. The fact is ignored that localizing masticatory pressure on the crests of the ridge is the principal cause of rapid alveolar resorption. The effects of tissue resorption are perfectly familiar to all of us. In addition to the torque on the anchor teeth and the orthodontic effects described above, the artificial teeth soon fail to meet their opposing teeth, throwing the force of mastication on the remaining natural teeth, with resultant traumatic occlusion. Now, gross tissue resorption under a partial denture is not an inevitable process. It can be retarded by correct partial denture procedure. If the occlusion is properly balanced; if there is adequate tissue coverage, and if provision has been made for compression of the mucosa under the saddles, resorption may be prevented for considerable periods of time, so that the patient may receive a genuine service from a partial denture that is properly made. Tissue compression is accomplished when taking the impression, or by rebasing the completed denture. It is a common error to treat rebasing as a corrective procedure for conditions that arise as a result of tissue resorption, rather than a preventive measure to be taken as soon as the denture has been completed, and before the

patient is allowed to wear it. All lower partial dentures should be rebased immediately, under masticatory stress. This procedure need not be repeated if the technic has been properly carried out, for the effect is to retard resorption by molding the mucosa to the saddles, by lessening pressure on the crest of the ridge, and distributing it equally all over the entire saddle areas; and by making it possible for the saddles to sink slightly into the mucosa before the occlusal rests are stopped by their seats, so that there is a division of the load between the alveolar process and the anchor teeth, and the latter are not subject to a torque.

It is not necessary to rebase upper partial dentures. Upper ridges are wider as a rule, and the lingual surfaces, particularly, are not so nearly perpendicular as the lingual surfaces of lower ridges. Consequently, there is more tissue surface to resist masticatory pressure in a vertical direction. Moreover, the histologic structure of the tissues utilized is different from that of lowers. The available tissue areas of lower cases consist almost entirely of scar or reorganized tissue; which is not true of uppers. Compression is necessary for upper dentures, but may easily be obtained by proper impression technic. In upper cases, it is particularly necessary to study the distribution of hard and soft tissue areas. If all of the soft tissue is not sufficiently compressed, there is danger of the palatal bar's impinging severely on the hard areas as the saddles sink into the soft tissue under masticatory pressure. Furthermore, the palatal bar or strap may even be bent, thus exposing the anchor teeth to "orthodontic" pressure.

The question of tissue coverage is no less important than tissue compression, and the safe rule for a saddle area is to make it as extensive as possible, the limit being determined by a careful preliminary examination of the tissues. To decide what part of the soft tissues should be covered by the rest of the structure, a study of the direction of masticatory stresses is essential, so that the proper tissue areas may be utilized for support. Occlusal stresses are of two kinds: the steady pressure of incision and the repeated impacts of mastication on posterior teeth. The former, in upper cases, involves thrusts in an outward and upward direction; in lower cases, a thrust downward and backward. The impacts of mastication, on the other hand, induce vertical stresses, upward in upper teeth and downward in lower, together with lateral stresses, the result of the lateral excursions of the mandible, in both upper and lower teeth. The only tissue areas that can be utilized for support are naturally those at right angles, or nearly at right angles, to the line of the forces to which they are exposed; for example, the crests of the ridges may resist the upward and downward pressure of mastication, and their sides the lateral stresses. The anterior part of the palate resists the outward and upward stresses of incision, but the soft tissue areas underlying the gingival of lower incisors can never be used for support. They will not help resist the stress of the incising bite, because, in the lower arch this is in a downward and posterior direction. They cannot help support the denture against the downward pressure of mastication, and if any attempt is made to employ them for that purpose, the effect is pressure against an inclined plane, forcing the lower anterior teeth in a labial direction

and carrying with them, ultimately, the upper incisors also. As has already been observed, upper posterior ridges present more tissue surface at right angles to vertical stress. In fact, in lower dentures almost the whole of the masticatory pressure is concentrated on the crest of the relatively narrow alveolar process. The construction of lower partial restorations offers by far the most difficult problem.

### THE RELATIONSHIP OF PARTS

Failure to maintain the proper relationship of the parts of a partial denture, and particularly of the clasps, a common error, is the immediate cause of the conversion of the denture into an orthodontic appliance. This failure may be due to defective technic, or to the choice of unsatisfactory materials for the construction of the denture, particularly for important structural elements, such as the "lingual bar" or " palatal bar."

Defective technic often begins with the impression itself. If the impression fails to register accurately not only the superficial details of the anchor teeth, but also their correct relative position and inclination, the initial error will be perpetuated throughout the construction of the appliance. The most desirable impression material, or procedure, therefore, is one that enables the operator to detect any such error at the very beginning. For this reason, modeling compound is not to be recommended. Even when a compound impression has been taken in sections, and the latter carefully removed in a buccal or lingual direction, along the line of least obstruction from the teeth, and even when every precaution has been taken to distribute pressure evenly on the compound when holding it in position, and to chill it perfectly during the whole process, there is still risk of warpage in the material. The most serious part of it, moreover, is that, unless this change is very considerable, it cannot be detected by the operator. Plaster of Paris, if fractured carefully so that the pieces are not too small to assemble, or so that their surfaces do not rub in the process, can be assembled so that any discrepancy can be noticed instantly, before any further steps are staken.

Plaster of Paris undergoes volumetric changes, particularly if it is not properly mixed, and unless the working cast is poured immediately, the warped impression will effect the relative position of the anchor teeth as reproduced on the working cast. The only safe materials to use for the working cast are those that neither expand nor contract, such as the better so-called artificial stones.

One of the most prolific sources of error is to be found in the incorrect assemblage of the parts of partial dentures that are constructed in sections. An excellent example of a risky procedure is that in which one half of a denture is cast and seated in the mouth, an impression is taken, the other half is cast, and the two parts are seated in the mouth for the final impression, so that they may be soldered together. Even when it is certain that the two sections can be seated in the mouth correctly, the hazard of preserving this relationship, while the impression is being taken, is very considerable. It is conceivable that much of the present reaction against sectional construction may be traced to unfortunate experiences with this slovenly technic. If, on the other hand, the sections are formed in wax after the clasps have been finished and seated on the anchor teeth, removed with in-

vestment cores and cast, they can be seated definitely on the hard model, and the correctness of their position can be easily confirmed, and maintained by waxing them to the model. The sections may then be removed with plaster or investment cores that serve both to register and preserve their relative position while being invested for soldering.

"Orthodontic" pressure on the anchor teeth may arise through the use of defective gold alloys for the lingual or palatal structures on which the *maintenance* of the relative position of the clasps depends. If the lingual or palatal bar warps when being soldered to the clasps, or when the latter are being soldered to the saddles, it is evident that the relative position of the clasps will be changed. It has been found that what are termed "wrought" bars are particularly liable to warp under these conditions. This applies not only to the commercial abominations known as the "ready made" lingual or palatal bar, but also to bars constructed by bending heavy pieces of wire or bar stock so as to fit the lingual or palatal areas.

This tendency of a bent piece of wrought metal to change shape, when heated, is not counteracted, moreover, when it is soldered to a matrix of platinum foil or of pure gold burnished to the model. In fact, these so-called "built up" or "matrix" bars warp more than any other type.

While the cast lingual or palatal structure seems to be exempt from the peculiar tendency of wrought metal, when heated, to resume the shape from which it was wrenched when bent to fit the model, a warning should be uttered against the use of cheap gold alloys with too low a melting point. A change of form is liable to occur even in a casting, if the metal is heated afterward to a temperature too near its melting point. For this reason, it is unsafe to use an alloy the melting point of which is very much below 1,800 F.

In this connection, it may be well to emphasize the importance of proper heat treatment after the appliance has been completed. It is difficult to exaggerate the importance of heat treatment for hardening gold-copper-platinum alloys. In the cooperative research between the Weinstein Research Laboratories and the United States Bureau of Standards, it has been definitely shown that this treatment produces changes in the actual structure of the metal, as well as commensurable variations in its reaction to mechanical stresses. The methods employed to test these variations and the data obtained by these tests have been explained in the published reports on the research. They make it certain that a very precise technic for heat treatment will sooner or later be developed and will become a familiar part of our every-day prosthetic laboratory procedure. Generally speaking, the research has proved that it is not merely gradual cooling that hardens the alloy: it is no less important to avoid overheating, and most important of all to sustain the hardening temperature before cooling the work. When it is realized that the toughness and elasticity of these alloys can be increased from 30 to 50 per cent, it is hardly necessary to expatiate on the value of the procedure in partial denture construction. This research has shown also that modifications in the proportion of platinum group metals, and in the amount of copper, in the presence or absence of other constituents, produce considerable variations in the susceptibility of an alloy to

heat treatment. It is evident, therefore, that we should be careful to use golds that are uniformly of the proper composition, if we are to benefit by the advantages of this procedure.

The practice of casting partial dentures, including clasps, in one piece is open to serious objections. Aside from the volumetric changes that may occur in a model investment "high" in plaster, the relationship of the clasps to each other is only too likely to be disturbed by one, if not both, of two factors: (1) the contraction of the mold during the elimination of the wax by heat or through the effect of the heated molten gold on the investment, in casting, and (2) the contraction of the gold when it congeals. In this technic, the only working model used is of investment, and is destroyed in the casting process, leaving no way to determine how badly the relationship of the clasps has been disturbed by shrinkage, except by seating the appliance in the mouth. In view of the ease with which natural teeth maybe moved, it is plain that this evidence is of little value. We all know how tooth movement has been exploited in the past for the insertion of " misfit" bridgework. Time alone can test the "one piece" casting procedure for large as well as small restorations, and prove that it is not injurious. The claim has been made that "it works," whatever that may mean. It is clear that the objections to it cannot be dismissed until clinical evidence has been obtained from a number of competent and impartial observers, extending over a period of from five to ten years.

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DISCUSSION

*H. F. Methven, Chicago, Ill.:* There are a few points that I should like to stress in order to bring them more forcibly to your attention. 1. No type of partial denture restoration completely restores masticatory efficiency, but if a careful and accurate technic is followed in its construction, it will not be an orthodontic appliance. It can be worn by the patient with great comfort, and it will increase the masticatory apparatus of the patient at least 50 per cent without exfoliation or movement of the anchor teeth. 2. The degree of efficiency obtained in any restoration depends entirely on the favorable distribution and stability of the remaining natural teeth. 3. Tissue compression in taking the impression is not necessary in the building of partial denture restorations. 4. Tissue absorption both of the hard and soft tissues is stimulated and increased by compression, and the main reason for using stops or occlusal rests is to prevent this compression as much as possible. 5. I do not agree that we must first take an impression in wax and then cut out a sufficient amount to overcome all undercuts, then oil this improvised impression tray and proceed to take a plaster impression. These thinner pieces are more difficult to assemble accurately than are the pieces, or fractured parts, of a full plaster impression; but I desire to emphasize that plaster or some soluble compound of plaster is the only material to be used for this purpose, for the reason that any plastic impression compound will draw, and in proportion as it draws, inaccuracy will follow. 6. Tissue absorption will and can be diminished or overcome only in proportion as the supporting or sustaining natural teeth, and not the mucosa, carry the burden of stress. 7. This means that, whenever possible, occlusal or lingual rests must be provided in order that the supporting natural teeth, and not the mucosa, may assume the stress of mastication. 8. Partial denture restorations become, or may become, orthodontic appliances only in proportion as an accurate technic may or may not be developed and followed. 9. Clasps are the most simple and least injurious type of attachments for removable appliances or partial denture restorations, and one should study the early literature of such men as Prothero, Bonwill, Wilson and many others on clasp construction. One form of clasp

will not do for all cases, whether made of rolled plate, bent wire or cast alloy, as the outline form and the position it occupies on the natural tooth has much to do with its retaining any orthodontic properties. 10. Clasps may be made separately of any of the above mentioned forms of alloys, provided they are fitted to their respective anchor teeth, and properly seated prior to taking the impression, and then accurately placed in their proper position in the impression before the cast is run in some more or less indestrucible material. If this is done properly, there will be no tendency toward orthodontic action. Or they may be cast as an integral part of the denture according to the accuracy of the technic followed. 11. It is recognized that the greatest possible degree of accuracy can be obtained by means of a plaster impression. Granting this, if a fusible metal cast can then be made from this impression, and used only as a master cast from which an impression is then taken with one of the soluble plaster impression compounds, from which an investment compound cast is made, the greatest possible accuracy is obtained. The wax pattern should be formed directly on this investment compound cast and the casting made directly on it. This technic eliminates the problem of failure because the master cast is indestructible and will serve for any number of impressions, in case of failure in the casting; and, in addition, it offers the further advantage of adjustment or readjustment should such be necessary before placing in the mouth. Again, in case of loss or breakage, it would only be necessary to go to the master cast and assemble the broken parts or make a new cast, this obviating the necessity of taking a new impression. 12. The possibilities of the casting process are practically unlimited, and success in casting any size of partial denture restoration will depend on the use of the proper compounds, and alloys, and the development of an exact technic. 13. In my judgment, the centrifugal casting machine is the best adapted for all large castings. 14. The heat-withstanding properties and the behavior of casting compounds, and casting alloys, are important factors in casting large pieces, and these considerations demand a thorough knowledge of the physical characteristics of all alloys and compounds used and a close careful technic at all times.

# THE STRUCTURE OF THE DENTAL ENAMEL*

By SAMUEL W. CHASE, Cleveland, Ohio

THIS paper is a preliminary report on work done during the last three years on the minute structure of the adult human enamel. The results of this work, summarized here, will appear at greater length and in more detail in papers to be published soon. The title was made general purposely because there will be discussed several separate, though closely related, aspects of enamel structure; the shape of the enamel prisms, the question of the presence of an interprismatic substance, and the nature and location of the organic formed elements of the enamel.

The structure of the dental enamel has been the subject of much controversy among histologists. The reason for this is obvious when one considers the technical difficulties involved in its study. Because of its peculiarly high inorganic content, decalcification by ordinary methods leaves practically no trace of structure. Because of its great hardness, it is impossible to cut sections except by the rather unsatisfactory process of grinding and polishing. The chief methods of study used in the past have been the observation of ground sections, the isolation of the elements by mechanical or chemical means and the observation of very young, imperfectly calcified enamel, which can be cut. None of these methods is, in itself, sufficient. Nor is a combination of all three methods productive of sufficient certainty of observation. Among the chief difficulties in the past have been the inability to obtain sufficiently thin, stainable sections, and the confusion of interpretation due to the refractive phenomena in ground sections.

I believe that I have succeeded in eliminating both of these difficulties in large measure by the use of the methods of decalcification devised by Bödecker and Malleson, in combination with other methods and with the use of stains which are selective for the elements of the enamel. Enamel decalcified according to these methods and modifications of them leaves behind the formed organic parts in their normal position. If the process of decalcification is stayed before decalcification is complete, the structural details of the enamel are still preserved, though the enamel is easily sectioned and is stainable. Removal of the mineral matter does away with many of the confusing refractive phenomena. Serial sections permit of tracing a given prism for some distance. The stainability aids materially in the study, as will be shown later.

*From the Laboratory of Histology and Embryology, Western Reserve University.

*Work done under grant from the Scientific Foundation and Research Commission of the American Dental Association.

*Read before the Section on Anatomy, Physiology, Materia Medica and Therapeutics at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

Sections of adult human enamel made by Malleson's method afford excellent material for determining conclusively the shape of the adult enamel prism or rod. V. Ebner and Smreker, together, were responsible for the conception of the prisms as arched on one side, channeled or grooved longitudinally on one or more sides opposite the convex side. V. Ebner noted additionally the frequent occurrence of bladelike alar processes, much like the processes of tendon cells in their appearance. Recently, these contentions have been somewhat vigorously denied by Jasswoin, Williams and others, who claim that the typical form of the enamel prism is that of the cylinder. Followers of the latter school contend that Smreker's arches and V. Ebner's alar processes are due in some way to failure to obtain sections directly at right angles to the long axis of the prism. My serial sections permit this difficulty to be overcome, as mentioned above, and show beyond a shadow of a doubt every support for the contentions of V. Ebner and Smreker. The arched and channeled prisms are extremely common, as are the alar processes.

The second question to be discussed involves an old and somewhat bitter controversy regarding the presence or absence of an interprismatic substance. Thought on the question has lately crystallized into two major views, championed, respectively, by V. Ebner and Walkhoff. Each has his host of followers, and there are many modifications of the views, but these two men can be taken as holding representative conceptions. V. Ebner believes the prisms are separated from each other by an interprismatic substance of usually measurable thickness, the substance of the prisms and that of the interprismatic substance being different. Walkhoff believes that the enamel is composed entirely of prisms, each prism consisting of a central core and a peripheral "prism sheath." The prisms, according to him, abut against one another and are held together, not by any cement substance, but by mere cohesion.

Sections prepared by the Bödecker or Malleson method and stained by Mallory's connective tissue stain give us a hitherto unused means of approach to the solution of this controversy, since the enamel is stained in such a way that the material of the prisms takes the fuchsin dye, whereas the material of the interprismatic substance takes the Lyons blue. Such sections show the prisms to be longitudinally fibrillated and translucent, while the interprismatic substance is homogeneous, transparent and of a glassy appearance. That the appearance of the interprismatic substance is not due to the process of decalcification is shown by observing the progress of decalcification of a very thin ground section of enamel under the high power microscope. When this is done, it can be seen that the dimensions and the appearance of the interprismatic substance do not change during the process. There is, at no time, any evidence of any interface lying half-way through the interprismatic substance between two given prisms, a feature that is demanded under the hypothesis of Walkhoff. The interprismatic substance, then, must differ both chemically and morphologically from the substance comprising the prisms. Further evidence of a chemical difference between these two substances has already been cited in my paper on Nasmyth's membrane[1] in which there is described a marked tendency for certain

1. Chase, S. W.: Anat. Rec., 33: 357-376.

bacteria (cocci) in the bacterial film found on most human teeth to become localized over the ends of the prisms and not over the outcroppings of the interprismatic substance.

Not only are the interprismatic substance and the prisms different chemically and morphologically; they are also of histogenetically different origin. Sections of the developing enamel of dogs show this conclusively, supporting in most respects the theory of amelogenesis recently put forward by Lams. According to Lams, the interprismatic substance is formed as a sort of continuously growing terminal bar apparatus, by this continuous growth building up a structure like the wax part of a honeycomb. The cells of the "honeycomb" are occupied by the Tomes' processes, by, in and about which the prisms are secreted. My material leaves little doubt in my mind that Lams has made the most nearly correct interpretation of amelogenesis. The fibrils seen in the adult enamel are, beyond a reasonable doubt, the remains of the fibrils so frequently observed in Tomes' processes.

It is these fibrils that furnish the formed elements remaining after complete decalcification of the enamel. None of my preparations, however made, shows any evidence of formed organic remains in the interprismatic substance; hence, it is probable that Bödecker has dealt with these intraprismatic fibrils when he thought he was seeing interprismatic fibrils.

My preparations show absolutely no evidence of enamel tubes. In places, the interprismatic substance is poorly formed and it is possible that spaces might have existed there in the enamel before decalcification, but, both from histogenetic considerations and from observation of preparations of adult enamel, stained and unstained, the conception of enamel tubes in human enamel seems to me to rest on evidence insufficient to make their acceptance advisable at the present time.

The enamel tufts and lamellae recently redescribed by Bödecker appear to me to be due to groups or sheets of enamel prisms in an imperfect stage of formation, though more work must be done on this phase of the enamel problem before a decision can be made.

## CONCLUSIONS

The theoretical hexagonal prismatic shape of the enamel prism is often distorted by grooving or channeling of one or more sides and by the convexity of the side opposite the channeled sides.

The alar processes described by V. Ebner are found on many prisms.

The interprismatic substance differs from the substance of the prisms chemically, morphologically and histogenetically.

There is no evidence of a prism sheath.

The longitudinal fibrillation of the enamel prisms is due to the remains of Tomes' processes of the ameloblasts.

The stainable formed organic remains of the enamel following complete decalcification are intraprismatic and not interprismatic.

No evidence of enamel tubes has been found.

The enamel tufts and lamellae are thought to be due to imperfectly formed areas of enamel.

## DISCUSSION

*Charles F. Bödecker, New York City:* It is naturally a pleasure to discuss a paper which deals with one's own investigations and delightful when such striking confirmation is presented as shown by Dr. Chase's work.

As I agree with all that has been presented,* it would only be an idle repetition to go over its individual points. I would like to elaborate on the function of these structures, but, as the time is short, I shall discuss briefly the clinical importance of the organic structures in adult enamel and their bearing on the problem of the all too common scourge of dental caries. Factors having a bearing on the importance of these structures are as follows: 1. Dental caries is doubtlessly increasing in the civilized nations of the world. 2. The teeth of individuals may be either highly susceptible, slightly susceptible or immune to caries. 3. The enamel of the teeth is the foremost and practically the only barrier against the destruction of the tooth through dental caries. 4. Environment cannot always be made responsible for dental caries, as we sometimes find filthy mouths in which the teeth are not carious. 5. It must, therefore, be the enamel which varies in its power of resistance to dental caries. 6. There is a question as to whether we can or cannot improve the enamel in its resistance to dental caries. 7. Black, Hopewell-Smith and, formerly, J. Leon Williams and others emphatically deny the possibility that this resistance can be increased. They claim that, once formed, enamel can never be improved in quality. If this were true, the work of the dental profession would be limited in future, as it has been in the past, to a constantly losing fight against dental caries, a constant repairing and patching of the teeth, beginning with younger and younger patients as time goes on. If dental caries increases at its present rate, it will finally become so rampant that the dentist will have to make porcelain jacket crowns and gold inlays for the babe unborn. No! Our reparative work is wonderful in replacing lost parts, but it does little in stopping the continuing spread of dental caries. 8. On the other hand, if we do *not* regard the enamel as a perfectly calcified and segregated tissue, but prove that it contains the organic structures just described by Dr. Chase, structures which are in connection with the blood plasma of the pulpal vessels through the dentinal tubules (Beust, Fish and C. F. Bödecker), the wonderful and consoling possibility is offered to mankind that we may reduce and finally eliminate dental caries by proper diet. Another possibility of more thoroughly calcifying the enamel, as advocated by Head, Anderson and some others and proved by the permeability experiments of Bunting and Rickert, is by the deposition of mineral salts suspended in the saliva. I have been successful in reducing the extreme susceptibility to dental caries as well as hardening the teeth of several young patients by this means. But the possibility of impregnating the enamel from the exterior with an added amount of mineral salts presupposes the existence of spaces in the enamel; and microscopic evidence, as well as chemical analysis, proves these spaces to be filled with an uncalcified organic matrix. I believe that Nature calcifies the enamel of erupted teeth as it does dentin and bone; that is, through the channels and by means of the blood plasma. In closing, therefore, I wish to emphasize the importance of definitely settling the question of the presence of these organic structures in the enamel and their connection with the general circulation of the body. Dr. Chase has done much with his valuable contribution to prove this point. We may, therefore, now go on with dietary experiments, such as those of McCollum and Howe, in the hope of reducing, by this means, the alarming spread of dental caries.

*Author's note: Dr. Bödecker errs when he states that my work is "striking confirmation" of his news. In several respects, my results are diametrically opposed to his published beliefs. Attention is called particularly to the intraprismatic position of the formed organic elements and to the total absence of a "prism sheath."

# THE EVOLUTION OF ORTHOPROSTHODONTIA IN MILITARY DENTAL SURGERY*

By JOSEPH D. EBY, D.D.S., New York City

NO doubt there are few if any of my listeners who were not alert in watching the work in which the professions of medicine and dentistry were engaged during the World War, from its beginning in 1914 until the entrance of the United States in 1917. All credit should be ascribed to the men thus engaged in those early days. I only wish that I had the resources available to herewith inscribe their names, but I can only say all honor and glory to them.

Conspicuous in France during this period was the work in Paris of the American Ambulance No. 1, and, in our particular field of endeavor, of Drs. Hayes and Davenport, with their able associates. During this same period of early work on maxillofacial injuries the great ingenuity of the French, headed by such men as Dr. George Villain and others, was rising to meet the demands which the War was thrusting on them. It was indeed fortunate that the United States could profit by their early experiences, for the benefit to our own soldiers, as well as to use our own resources to the best advantage for the benefit of our allies.

During the summer of 1917, the office of the Surgeon General of the Army had to expand to hitherto unheard of proportions to meet the exigencies of a great war. At this juncture, the finest trained men were absorbed with the task of taking the basic specifications of facts in hand to project them through plans and methods of organization calculated to be most effective. Here, again, it was proved that the combined efforts of the most brilliant intellects cannot always foresee all of those finer details that are brought out later through actual and practical experience.

During this period, schools of oral and plastic surgery were organized in the United States, with the object of training selected medical and dental officers in the coordinate work of treatment of wounds through the face and jaws. From groups thus trained, the original plan was to select "head teams" composed of a brain surgeon, a plastic surgeon (preferably an ear, nose and throat specialist) and a dental surgeon. This plan was abandoned before being put into effect because the changing style of main offensive warfare produced multiple wounds of such a character that either the casualties could not be so isolated, or the "head teams" be so diffused to meet the needs of the majority of soldiers with scattered wounds.

*Read before the Section on Military Surgery at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

The men who passed through these schools were segregated into a group, later to be drawn into the base hospitals in France, where the efforts at their training were richly rewarded by the benefits of their service in the preventive value of early work properly done.

SURGERY

I feel that, at this point, it is my duty to express myself on the subjects of teamwork and coordination, and to estimate, as nearly as possible, the relative order of importance and the degree of responsibility to be recognized and shared by specialists in different fields engaged in the same work. I hope that my impressions will cause no misrepresentations.

It is my belief that the maxillofacial or the oral surgeon, if he may be so called, should hold the position of greatest responsibility. He is compelled to assume the greatest degree of surgical risk, even to the point of responsibility for applying life-saving measures. It remains for him to direct and plot the course of treatment that will make for the greatest measure of recovery. He should preferably hold both medical and dental degrees, and in more than name only, in order that he may direct with clear vision and appreciation the duties of his associates.

In my experience at various training schools and general hospitals of the Army, I did not observe in any other department a greater need for careful selection of officers than in maxillofacial surgery. To say the least, these men cannot be of a single-track mind, neither can they be so greatly absorbed in their own actual duties as to be prepossessed thereby, or visibly minimize the importance of other work on which they are dependent.

It is my belief that if a competent maxillofacial surgeon has attached to him an orthodontist, trained in the ways of dental orthopedics, and a prosthodontist who is versatile beyond the point of the conventional denture, he should be capable if surrounded with proper equipment and facilities, of producing a maximum degree of improvement in any form of wound beneath the eyes and above the neck.

ORTHODONTIA

There is no segregated specialty of medicine which does not abut on, or dove-tail into, associated sciences in different directions. Orthodontia is that specialty of dentistry which deals with the correction of malocclusions of the teeth and surrounding parts, yet all its mechanical phases must be considered in terms of applied therapy. On the boundary line of oral surgery, its relationship to oral surgery becomes the same as that of orthopedic surgery to general surgery. The effects sought are different in that, instead of moving teeth in groups or individually, the process becomes a consideration of moving or sustaining fragments of the maxilla and mandible *en masse*. The basic mechanical principles cannot be varied essentially, and this fact should be recognized by every individual thus engaged. The most baneful practices that have been inflicted on humanity in the guise of orthodontia have followed the empiric methods of individual geniuses. I am prepared to believe that equally proportionate effects have resulted in the construction of splints in the treatment of fractures. If the human mind is given a thinking formula, the results become an applied science, and the fantastic creations of unfounded efforts, soon disappear.

As the result of my experiences, the advice which I should prefer to hand down to our predecessors would be that, in the construction of any type of dental orthopedic device whether orthodontic or prosthodontic, there should be two basic elements of control: first security of anchorage; second, simplicity of design. If this simple formula is steadfastly adhered to, results, as a rule, will be satisfactory.

The surgeon the orthodontist and the prosthodontist should be men of such experience as to possess a keen insight into each other's work. In the plan of treatment, orthodontia enters with surgery through first aid and the intermediate period of primary healing and seasoning. During the second period, different types of splints have to be supplemented for those employed for first aid immobilization as a rule. Then follows the period of preoperative preparation for reconstruction in which the orthodontist is still engaged with the oral surgeon, but during this period the prosthodontist enters. The operative period immediately following calls for the combined efforts of both orthodontist and prosthodontist; then continuing into the postoperative period, the duties of the orthodontist gradually drop off, and the prosthodontist, in the fullness of his scope and to the extent of his own versatility takes final charge.

### PROSTHODONTIA

Prosthodontia is that specialty of dentistry which deals with the replacement of lost teeth and surrounding parts. What could the prosthodontist do if the orthodontist had not placed the remaining parts in functional relation? What could the prosthodontist do if the oral surgeon had not prepared the bed of a bone graft, or draped the overlying soft tissues so as to receive proper maintenance and support for the prosthodontist's restoration?

I would like to present a picture to your minds. A prosthodontist stands at the chair beside a soldier in whose mouth he has placed two beautiful restorations. As the result of these restorations there have been restored function, phonation, appearance, and assurance to the soldier that he has been restored to a life of mental aggressiveness and physical usefulness. Beside the prosthodontist stands the oral surgeon, who removed sequestrums, prevented fatal secondary hemorrhage, successfully inserted a bone graft, and smoothed out the soft tissue defects. Nearby stands the orthodontist, who placed the remaining fragments in correct position and sustained them securely through the bone grafting and other stages of progress. Is it not easy to realize that unfathomable sense of gratitude, the result of such a degree of team-work, by which each was not only inspired in his own endeavor but encouraging to the other? That, my friends, is service, that is coordination. Without the proper appreciation of value of one another's work, the operators may leave the patient with a lifelong burden of discomfort, disability and humiliation.

### TREATMENT

It is the best plan for all parties concerned to agree on the treatment before anything is attempted. It should be the duty of the oral surgeon to acquaint his associates exactly with the general plan of conduct of the case. This suggestion may be more or less difficult of accomplishment until the wounded soldier arrives at the general hospital where the final reconstruction work is to be completed. At this loca-

tion, the oral surgeon, the orthodontist and the prosthodontist should take all available data on each individual case, make a thorough study and plot such a definite course of treatment that, save for unexpected happenings, the policy agreed on could be followed unerringly. The prosthodontist, in his department, should be of invaluable assistance to the orthodontist in the construction of splints and other mechanical apparatus. The orthodontist should be capable of assisting and rendering able suggestions to the prosthodontist as to the design of dentures and the best forms of attachments. Both orthodontist and prosthodontist should be capable of assisting the oral surgeon in the operating room whenever their services are required, and the oral surgeon should have at least a comprehensive grasp on the work to be performed by his two associates. But beyond a certain point, they should be capable, and he should understand that they are to be left alone. Under no circumstances should any one of the three men ever dominate the others by incompetent suggestion.

My concluding thoughts naturally revert to an army as a unit. No modern military organization can be arranged for the special benefit of any individual. I have never seen or heard of a man worth his salt to any military organization who had his personal worth and importance self-appraised to the point of oblivion to the pursuit of duty and the ends of best accomplishment. Discipline may be enforced, but it is through self-respect, self-discipline and due consideration to others that the secret of success in all combined effort is to be found.

The object which should be held constantly in mind from the first interference with a maxillofacial wound should be to attain the greatest ultimate restoration to appearance and function, and to safeguard against any modification or liability in the form of a lifelong disfigurement. In consideration of the mechanical point of view of this paper I must again emphasize simplicity of thought and method. As much damage can be done by attempts which complicate and overdo the requirements as may follow from misdirected or insufficient attention. This work has little place for the pursuance of hobbies, fads or personal obsessions. All orthodontia, all prosthodontia, and any of their combinations, should be as much a prescribed therapy, expressed in the form of properly made apparatus, as a medicine for some constitutional disorder, as far as the foundation of facts observed are concerned. I believe that the policy of stability of anchorage and simplicity of design will go further in this direction than any other plan.

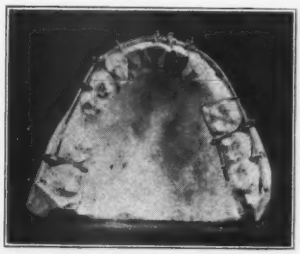

Fig. 1.—Orthodontic first aid treatment, French method.

### FIRST AID

The finest method of first aid treatment from an orthodontic point of view which has come to my observation was brought out by the French, as illustrated in Figure 1. It was their plan for every dental officer to carry what was

known as a first aid kit, in which the parts of this apparatus were included. The arch bars are made of nickel silver and there are small tubes prepared of various lengths to fit, to which are soldered transverse wires about 0.030 gage. With the aid of pliers and scissors, these tubes may be slipped on to the conformed arch with the transverse wires inserted beneath the points of proximal contact of the remaining teeth. These transverse wires are bent around lingually and ligated to position with a degree of security which will overcome

Fig. 2.—Adjustable head-gear designed by James E. Aiguier.

all individual muscle action, bringing the teeth into occlusion and the bone fragments into correct apposition. Numerous experiences with this apparatus have always proved its efficacy and I strongly recommend it as a part of field equipment for the first aid and intermediate treatment of fractures of the mandible. The point to be observed about this apparatus is the manner in which it supplements the need of bands, other time-taking preparations, or the closing of the mouth interdentally.

Figure 2 illustrates the adjustable head-gear designed by James E. Aiguier, of Philadelphia. This is a most admirable piece of equipment both for field and for hospital use. These pictures demonstrate how it may be employed in many ways with bandage material for instance, or with the heavy chin support designed by the French, which has many advantages in first aid immobilization. This head-gear, so readily adjustable is also very effective in connection with intra-oral splints or the application of the Kingsley principle in the treatment of fractures of the superior maxilla.

The first aid treatment of maxillofacial injuries is a great problem at best, as the injuries usually occur at a time and place, and are associated with shock,

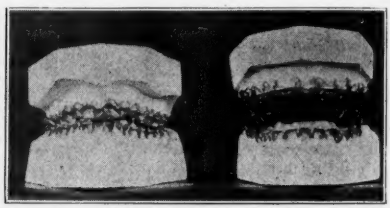

Fig. 3.—Intermediate splint.

multiple wounds and other conditions, which preclude the presence of proper facilities or the ability to use them. For these reasons, no superfluous apparatus should be carried for field work, and the most careful preparation of articles that are to be carried to the front should be made.

### INTERMEDIATE SPLINTS

Usually, several days intervene before a maxillofacial wound can receive major corrective treatment. This is due to the lines of transportation back as far as the evacuation and base hospitals, as well as the period to be allowed for recovery from hemorrhage, shock and other early involvements. Too much cannot be said concerning the preventive value of early treatment

properly performed. This work should have as its object the restoration of occlusion and facial balance, and the proper apposition of all bone fragments as speedily as possible. The sooner fragments can be placed securely in position, the sooner the genetic activities of solidification will begin. When fragments remain movable, irritation increases, and the inflammatory processes are provoked to a degree of infection, which undermines the periostium, diverts nourishment to fragments and invites the death of valuable tissue. Naturally, all this brings in serious complications, greatly prolonging treatment and lessening the quality of the final result.

An efficacious type of intermediate splint is illustrated in Figure 3. It consists of upper and lower swaged or adapts caps of 36 gage German silver reinforced with 0.040 circumferential wires made of the same material. To these are soldered hooks pointing upward on the upper and downward on the lower, so that when they are cemented to position, fragments may be brought together and the jaws secured by means of ligatures. In the later stages of treatment, reciprocal rubber elastics may be employed to permit opening of the mouth in case of an emergency. Figure 3 also illustrates the possibility of tying blocks between these caps for the purpose of keeping the bite open, for safety or other reasons.

Fig. 4.—Above: Application of splint shown in Figure 3. Below: Open bite splint in a similar case.

It is an easy matter to send out the necessary material and equipment for the construction of splints of this character with base hospital supplies to expeditionary forces. A large number of cases in which this splint was inserted in France came to my attention later, and without exception they were highly successful. In types of wounds in which this splint was used, we were generally able to prepare radiographic surveys of the jaws and teeth, and on the removal of the splints, we found secure solidification, and after the removal of all

traumatized teeth and their replacement with partial dentures, these soldiers were discharged. Treatment was short and inexpensive, with but a small percentage of disability and a splendid condition resulting.

The upper half of Figure 4 is a typical illustration of the efficiency of this splint; whereas, the lower has an open bite splint in a similar case. The bone fragments in the lower case solidified in a vicious union, leaving the patient with an open-bite nonocclusion which required a year of harrassing treatment and the final extraction of some teeth. The upper splint certainly serves the best purposes from an orthodontic point of view.

Fig. 5.—Cases illustrating value of early treatment.

The series of photographs in Figure 5 illustrate how the entire future of a wound is established by the early attention it receives. This officer was shot squarely through the chin, and the symphysis shattered into small fragments. The apparatus prevented collapse of the lateral divisions of the mandible and the region of the wound was sustained so that drainage and nourishment were accomplished and thus several of the larger bone fragments were enabled to retain their vitality, which under any other condition would have been lost. Later, a plaster impression was taken, into which was poured Mellotes metal, which, when reinforced on the base with plaster, produced the model seen in *6*. Thus, a quickly prepared and accurate model is obtained for the construction of cast caps. The one shown in this picture is made of 90 per cent silver and 10 per cent copper. The depressed bar of nickel silver connecting the two sides is rectangular, about 2 mm. thick and about 4 mm. wide. The camouflage denture has three spring clasps similar to the Gilmer attachment, which snap over this bar. This final splint was placed in position when the radiogram shown in *5* revealed three or four as yet unconnected but vital fragments of bone remaining. At *10* a radiogram taken several months later shows complete solidification. The patient, an officer, was spared the necessity of a bone graft and received a maximum degree of improvement with very simple follow-up treatment, for which the

Fig. 6.—Case illustrating simplicity of procedure and value of cooperation of maxillofacial surgeon, prosthodontist and orthodontist.

credit is entirely ascribed to the first splint. The other pictures in this figure speak for themselves as to the cooperation between the prosthodontist and the orthodontist.

FINAL SPLINTS

Figure 6 shows a case wherein the mandible was lost from the right cuspid through and including the head of the condyle, with the characteristic collapse resulting. Cast silver anchorages were employed to which were extended buccal flanges similar to the plan first devised by Dr. Gilmer as far back as 1878. The straight extension soldered to the upper fitting inside the looped extension into the lower buccal sulcus made it possible for the patient to open his mouth approximately 30 mm. without "jumping" these planes. This device was first left open to invite relaxation of the tissues in correct position, but threaded holes had been prepared into which set screws were inserted during the period of the bone graft. The graft inserted by Robert H. Ivy was taken from the left sixth rib, with a rounded head for the condyle fashioned from costal cartilage, which was removed, attached to the rib. After a period of several weeks, the lock screws were removed and the splints left in position, in order to take the strain off the graft, for a considerable additional period of time.

Fig. 7.—Type of interdental splint devised to control edentulous posterior fragments of the mandible.

Fig. 8.—Models and application of splint illustrated in Figure 7, showing security and simplicity of design.

This splint was finally removed and a denture inserted, and when this soldier was last heard from, in March, 1924, five years later, the graft was in most excellent condition, and he was still wearing the denture prepared by Roy L. Bodine. This case, to my mind, illustrates simplicity of procedure and cooperation in the three phases under consideration.

Figure 7 illustrates a type of interdental splint devised to control edentulous posterior fragments of the

mandible. Owing to the effect of the elevator groups of muscles, these posterior fragments present the most serious problem to all concerned. By the use of saddles, it is relatively easy to stabilize them sufficiently for grafting, but it is a difficult matter to create any traction by which to improve their positions, as shown with the screw attachment and swivel joint made in the saddle in *3*.

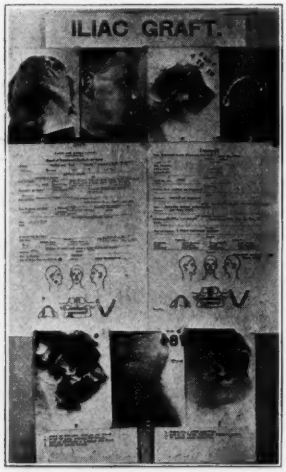


Fig. 9.—Case of extensive loss in body of mandible replaced with graft from ilium and solidified eventually under type of splint shown in Figures 7 and 8.

The middle illustration of this group shows the use of a horizontal lock pin made to slip through tubes which are soldered alternately in the buccoclusal margins of the upper and lower caps. In order to produce what in orthodontia is known as a stable anchorage, these cannot be round tubes unless a brace bar is used somewhere to prevent rotation. The tubes shown in this illustration are square, but Edward Kennedy of New York has used and suggests a rather wide and flat tube so that, as the bones begin to solidify, the lock pin can be filed down gradually to impart a little motion which stimulates additional genetic activity in the bone with beneficial effects. This valuable suggestion, as far as I know, is original with Dr. Kennedy.

Figure 8 shows that this splint is strictly the outcome of a design based

Fig. 10.—Extensive case calling for cooperation of maxillofacial surgeon, prosthodontist and orthodontist.

on security and simplicity. This simple inferior dental splint was used in numbers of mandibular grafts even osteoperiosteal grafts as much as 1 inch in length, wherein the mouth was never closed with interdental attachments. This splint illustrates the necessity of clamp bands on individual teeth, it having been found that plain bands or small cast caps easily become uncemented. As the entire success of a bone graft is dependent on immobilization, it is not safe to rely too much on cement to hold a cast cap in position. This is due to

the considerable strain exerted against it. In order to forestall this liability, it is wise to use interproximal set screws

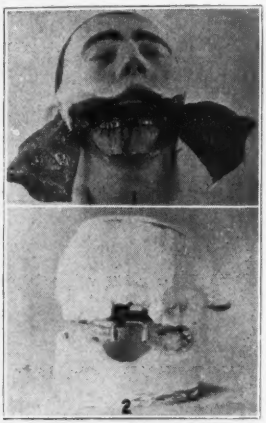

Fig. 11.—Mechanical execution, by gradual reduction of fractures, of principle recognizing genetic activity of bone.

threaded between the teeth beneath the points of proximal contact while the cement is still soft. In silver alloy castings, these will hold securely and can easily be cut out.

Figure 9 illustrates a case of extensive loss in the body of the mandible which was replaced with a graft from the crest of the ilium and solidified eventually under this type of splint. Why use more?

Figure 10 illustrates a very extensive case, the entire success of which was dependent on the cooperation of the maxillofacial surgeon, the prosthodontist and the orthodontist. The ultimate loss in this mandible extended from the third molar on the right side to the second molar on the left. There was a severe collapse of the remaining fragments, which had been handled admirably in France. At 7 are shown the parts of this splint dissembled. In the upper arch, clamp bands were used for anchorage, to which were soldered the horizontal square tubes into which the lock pins fastened. In the lower arch, a cast cap was used on the left side, and a clamp band on the single remaining tooth on the right side. It will also be noticed that a prosthodontic device was added in the form of a vulcanite plumper which could be fastened to position at the time of loosening the adhesions and performing the plastic

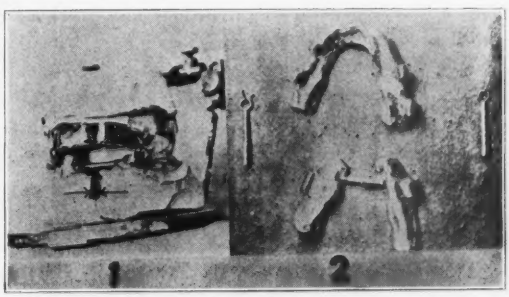

Fig. 12.—Case in which genetic activity of bone was only partially taken advantage of.

operation on the face. This splint certainly shows how intimately interwoven the orthodontic and prosthodontic principles of treatment sometimes are.

At *11*, this splint is shown as it was finally assembled in the mouth, and at *12*, a partial idea is given of a 4½ inch graft from the crest of the ilium which solidified beautifully. This splint and the final denture work was prepared by Roy L. Bodine, and the

Fig. 13.—Case in which premaxilla and all teeth from right cuspid to left third molar were destroyed.

surgical work performed by Robert H. Ivy. Several years after this officer's discharge, a denture was prepared by Edward Kennedy, consisting of a gold base with vulcanite attachment, and in order to relieve all unnecessary strain and not endanger the priceless teeth remaining, the clasps were fastened to the denture by means of Dresch attachments. The apparatus has proved a great success for more than three years.

GRADUAL REDUCTION OF FRACTURES

There is a great orthodontic principle which should never be lost sight of in this work, which recognizes the genetic activity of bone and takes advantage of it to the extent of saving much surgery at times. Figure 11 illustrates the principle mechanically executed by the gradual reduction of fractures. When there has been a loss of not more than one-half inch of substance in the region of the symphysis, and sufficient anchorage remains on both sides of the lower

Fig. 14.—Case of tissue destruction and fracture in which orthodontic appliance was successfully employed.

arch, it is possible to use a type of splint which gradually expands the arch during the period of partial union, and the gensis of bone will follow readily. At the left, the general effect on a plaster cast is shown; at the right, a practical case in which about one-half inch of bone was actually grown. This should be regarded as good orthodontia.

Figure 12 illustrates a case in which this principle was only partially taken advantage of. There had been a loss of substance in the symphysis, with con-

siderable destruction of the inferior border and resultant collapse and partial solidification. At first, only the lower

Figure 13 illustrates an interesting case wherein the path of a missile had destroyed the premaxilla and all the

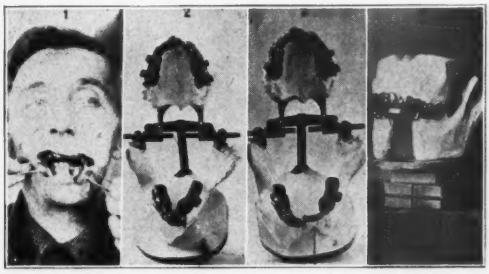

Fig. 15.—Employment of orthodontic principles in radical reduction of fractures.

splint was inserted and the jack screw tightened until correct occlusal relations were restored. Then by means of lock pins, the mandible was further immobilized to the superior maxilla, and the bone graft was inserted as much for

Fig. 16.—Simple orthodontic method for final equalization of occlusion by appliances anchored with plain bands.

the cosmetic effect as for security of union. Perhaps the interdental attachment was unnecessary.

teeth from the right cuspid to the left third molar. The right fragment, including all the teeth, was loosened, and had partially solidified, with the buccal surfaces of the upper teeth striking against the lingual surfaces of the lower. The only secure process in this arch was that of the left third molar, and the bone in the region of the tuberosity. A clamp band was fitted to this single molar, and a large silver casting was soldered to it which rested over an area of soft tissue with an extensive flange intercepting the lingual surfaces of the left lower teeth. By tightening the two jack screws, the entire right fragment was gradually "jumped" over into occlusion. Immediately thereafter, Dr. Bodine inserted a denture which made for the permanent retention of the result.

Figure 14 illustrates a case wherein a bullet destroyed much tissue in the bicuspid regions of the upper arch and fractured the segment containing the anterior teeth, which collapsed

and partially solidified in a position considerably lingual to the lower arch. An orthodontic appliance was inserted in the lower arch with hooks pointing upward and forward in the cuspid region for the attachment of intermaxillary elastics to the hooks soldered on the buccal surfaces of the molar caps on this upper splint. By the gradual tightening of the nuts on the

Fig. 17.—Loose fitting cast caps which may be removed at meal time.

jack screws, this anterior fragment was jumped over into correct incisive relation and the immediate insertion of Dr. Bodine's denture stabilized and rendered permanent the result.

RADICAL REDUCTION OF FRACTURES

Figure 15 illustrates the use of principles of orthodontia in the radical reduction of fractures. *1* shows the loss of substance from the right lower lateral to the left lower first molar, with resultant collapse and solidification; 2 shows the preoperative preparation made in the form of the cast cap anchorages cemented to position. This fracture was then loosened surgically by cleavage, and the lock bar, as shown in *3*, together with the interdental horizontal lock pins, immediately immobilized the fragments in position and prepared the case to receive a bone graft later.

EQUALIZING THE OCCLUSION

In many cases, it found, after the final removal of splints, that the general functional and occlusal relations be-

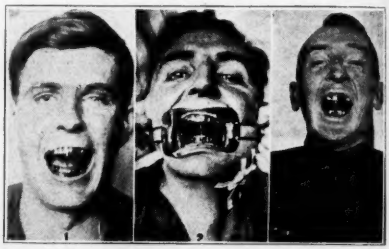

Fig. 18.—Different types of cases.

tween the teeth were not satisfactory. Figure 16 illustrates a simple orthodontic method for the final equalization of occlusion by means of simple appliances securely anchored with properly made plain bands. Hooks may be soldered in any position to create the desired direction of traction by means of intermaxillary or reciprocal elastics, which, in time, prove very effective.

TRISMUS

Orthodontia has long since abandoned the application of powerful intermittent forces, realizing that all tissue will yield much more effectively to the mild, constant and suggestive stimulation of such

a force, best provided by the use of a spring. In cases of trismus caused by adhesions limiting the motions of the mandible, various methods may be employed. These adhesions may be mildly osseous, or, as is principally the case, may be due to the contracture of scar tissue or the adherence of fragments of muscle which have healed in malposition.

Figure 17 shows loose fitting cast caps which are not necessarily ce-

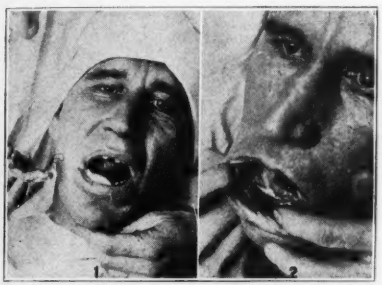

Fig. 19.—Typical case in which, by means of Jackson orthodontic appliances, plumpers of modeling compound were used to hold grafts in position.

mented to the teeth, in order to enable the patient to remove them three times daily for the encouragement derived from enjoyment of his meals. With the use of the adjustable jackscrews, for about an hour each day, the adhesions can be powerfully stretched. After this treatment, the tightening of the buccal springs will produce a constant pressure against any voluntary motions, which will so play on the adhesions as to gradually and permanently overcome them. I have seen cases of trismus in which the mouth was forcibly stretched to the maximum with the use of vertical jackscrews, which caused the patients great distress and produced only fairly good permanent results.

Figure 18 illustrates three cases of different types. At the left a case of adhesions in the right internal pterygoid muscle is shown; at the center, a case of osseous infiltration into the left masseter muscle, and at the right, a case of adhesions between the left coronoid process and the zygoma.

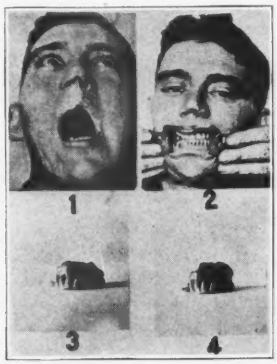


Fig. 20.—Method in which cooperation of oral surgeon and prosthodontist makes unnecessary the aid of the orthodontist.

### EPIDERMIC GRAFTS

As we gradually progress through the various stages of healing, we approach the period wherein the importance of orthodontic procedure is gradually beginning to wane, and prosthodontia becomes more vital. Frequently, at the stage where all other work about a wound is completed, it will be found that adhesions which obliterate the sulci in the vestibule of the mouth greatly hamper or preclude the insertion of a useful denture. These cases may be entirely overcome by the use of epidermic grafts.

Figure 19 illustrates a typical case in which the lower lip was completely adherent, and, by means of Jackson orthodontic applicances, plumpers of modeling compound were used to hold the epidermic grafts securely in position. In this, the orthodontist makes the preoperative preparation and may assist the oral surgeon during the operation. At the left, the epidermis is placed over the modeling composition plumper and ready to be brought into position. At the right, the result of the union several days later is shown. The beauty of this method is that the orthodontic apparatus may be worn as a retainer until the denture is inserted. In this way, a complete mechanical control is assured, and there are no rough edges of redundant tissue along the margin of the graft as would result from the burying of a "stent" with sutures.

Figure 20 illustrates another method wherein the prosthodontist can assist the oral surgeon entirely without the aid of orthodontia. Above, left, is shown a completely adherent upper lip; below, left, a denture made to fit the defect; and below, right, how modeling composition was added to the denture during the operation, later to be reproduced in vulcanite with the final result shown above, right.

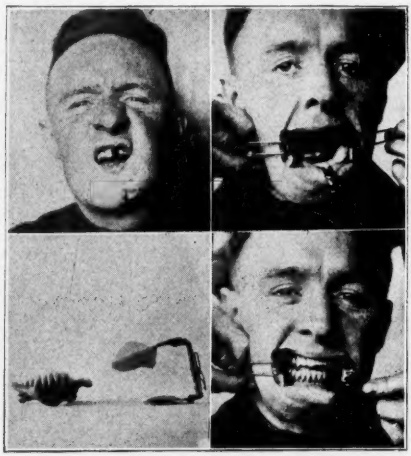

Fig. 21.—Case in which the mandible was lost from angle to angle, successfully restored by bone grafts and epidermic inlay, permitting stability of artificial dentures.

Figure 21 illustrates a case wherein the mandible was lost from angle to angle, and after the bone grafts were completed, there was a perfectly smooth surface of mucosa from the margin of the lower lip down into the floor of the mouth without a vestige of ridge or sulcus on which to build a denture. This patient would otherwise have been forced to go through life without lower teeth save for the possibil-

ity of establishing a sulcus by means of an epidermic inlay. After preparation of a deep incision, a modeling composition insert was fashioned to sustain the epidermic graft. This apparatus was worn assiduously until the completion of the denture by Dr. Bodine, and it was the greatest surprise to this patient that he was later able to masticate any staple foods with the denture remaining securely and comfortably in position.

Fig. 22.—Case of perforation between nasal and oral cavities. These can be closed by dentures, but should be closed by tissue if possible.

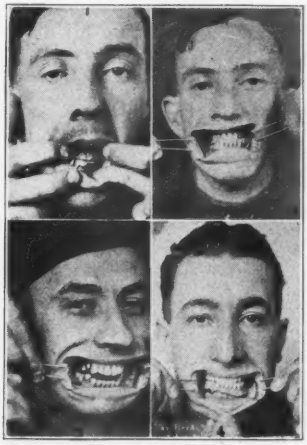

Fig. 23.—Prosthetic restorations by Bodine.

PROSTHETIC CLOSURE OF PERFORATIONS

Figure 22 illustrates a case wherein a perforation between the nasal and oral cavities was decided to be inoperable, at least for the time being, or until after a further period of delay. These perforations may be closed quite effec-

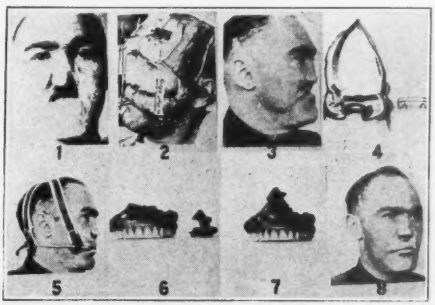


Fig. 24.—Case illustrating attainments possible under coordinate efforts of maxillofacial surgeon, orthodontist and prosthodontist.

tively by dentures, although the fact should be recognized that, owing to the association of nasal and oral secretions, these perforations should be closed with tissue when possible.

PROSTHETICS

Figure 23 illustrates some characteristic prosthetic restorations, prepared by Dr. Bodine, which illustrate average cases and their final preparation prior to discharge.

The concluding case presented in Figure 24 is, to my mind, final evidence as to the attainments possible under the coordinate efforts of the maxillofacial surgeon, the orthodontist and the prosthodontist. This is a case of loss of the anterior three-fifths of the palatal processes, and total obliteration of all maxillary tissue anterior to and including the loss of soft tissue apparent in *1*. The apparatus shown in *2*, as prepared by Dr. Storz, was made for the support of the double pedicle flap from the vertex of the cranium. This operation was performed, and the flaps later re-turned by Dr. Shaeffer at General Hospital No. 1, Ft. McHenry, Md. *3* shows final healing and shrinkage of this graft, and *4*, an adaptation of the Kingsley principle for the support of an apparatus made to hold securely an adjustable "grid," which is seen in the right of this picture. The inner surface of this graft was split so as to open it out, and the midregion of the face was loosened by undermining. This operation was performed by J. D. Whitham. The apparatus was then inserted and a plumper of modeling composition fastened over the "grid," which sustained the epidermic graft inserted to line these inner areas. After healing, a two-section prosthetic restoration was prepared by Dr. Bodine. The small insert could be placed on the tongue, elevated to position and grasped at the region of the columella, then the main portion of the denture could be inserted and snapped to position by means of Gilmer attachments. These operations and this apparatus gave a maximum restoration of appearance, partial function and complete phonation, thus restoring this patient to a life of activity and usefulness. This case illustrates to a maximum degree the possibility of attainment when the proper coordination between maxillofacial surgeon, orthodontist and prosthodontist is attained.

DISCUSSION

*James E. Aiguier, Philadelphia, Pa.:* Dr. Eby has brought out the need for orthoprosthodontia in military dental surgery, or, as he describes it, a combination of orthodontia and prosthodontia. Those of us who have had any experience in the world war recall the necessity of having a good knowledge of both of these branches of dentistry in order properly to handle the many cases presenting themselves. During my connection with a base hospital in France during the War, we had many trying cases relayed to us, and, in many instances, if the simple emergency methods had been applied, with a fair knowledge of orthodontia and prosthodontia, we should have saved many hours of labor. Many of these cases showed the work of one who had been trained to perform in groups or teams, for he had applied the emergency methods in such a way that we could carry on the work where he left off, but in all instances in which the patient had passed through a field hospital where the surgeon had not been trained along these lines, we had to start from the beginning and were severely handicapped by Nature in her effort to bring about healing. I agree with Dr.

Eby that orthodontia plays an important rôle in this work, and the greater the knowledge one possesses, in this specialty, the easier it will be to meet the many obstacles arising. As for team work, those of us who have been in the service realize that this is absolutely essential for attaining the highest ideals in our field of endeavor; for in no way would it be possible to carry out this work successfully without the cooperation of all individuals concerned. That the surgeon, the orthodontist and prosthodontist should be men of such experience as to possess a keen insight into each other's work is essential. Our experiences in the late War proved that the dental surgeon can make many suggestions to the maxillofacial surgeon that are of great benefit in making restorations. The schools of oral and plastic surgery were established in this country at the outbreak of the World War, so that the maxillofacial surgeon would understand the problems that confront the dental surgeon and the dental surgeon would likewise understand the problems confronting his colleague. The dental surgeon in field work should have a comprehensive knowledge of orthodontia and prosthodontia for the emergency work which he has to meet. First aid measures, properly applied, are a start in the right direction as a time saver, and in many instances result in the preservation of much facial structure. The teams consisting of the maxillofacial surgeon, the orthodontist and the prosthodontist did wonderful work in the base and reconstruction hospitals in the followup work. When we see the final results in some of these cases that have passed through our hands in France, we have the greatest admiration for the work carried out by these men.

# EXAMINATION AND CASE RECORDS*

By ELMER S. BEST, D.D.S., Minneapolis, Minnesota

THE greatest need at the present time in the development of dental science lies in the field of diagnosis. It is here that we determine the success or failure of our efforts. Regardless of the technical skill displayed in reconstructive dentistry, if it is not based on a sound and solid foundation, it results in failures of varying degree.

The need of a simplified, well-balanced and rational form of diagnosis is needed to a greater extent than at any time in the history of dentistry.

In view of the fact that much of the reconstructive dentistry which we see is a failure, owing to the fact that it is not constructed along certain basic principles that should govern it, it is apparent, in view of our development along other lines, that we are on the verge of an era that will be more or less revolutionary in character.

The work that has been done and the results that have been accomplished in reconstructive work when the principles of balanced occlusion have been carried out is a strong indication of this. Dentistry has made many mistakes in the past and will make many in the future, just as, of course, mistakes are made in other fields of endeavor, including all the branches of the healing art. This is to be expected, and no censure should be directed at it; for truly we live and learn. In our own process of development, many new phases of dentistry will be brought out. Conservative dentistry does not imply that we adhere rigidly to the old forms of our predecessors; nor does a liberal view of dentistry mean that we should try out, in its fullest sense, each new fad and fancy. It does mean, as I see it, that, through our own reasons process, unbiased and unprejudiced, and by free and frank discussion with our confréres, we make an honest effort to separate truth from fiction and apply the principles that are for the betterment of our profession and raise the standard of our services to our patients.

There is so much of interest; so much that is new; so much that is helpful in the field of diagnosis, that it is difficult to dissociate those parts that are so closely interrelated and discuss a separate phase of the subject. I shall endeavor to confine what I may have to say under the head of examination and case records.

This subject will be handled entirely from the standpoint of the general practitioner. In my opinion, there has been altogether too much rambling into the field of medical science, and too often this work is placed in the field of the specialist, where it does not belong.

Case records have a big place in the

*Read before the Section on Periodontia at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

*This paper and the papers of Drs. Hartzell, James, Garvin, Smith and Merritt make up a symposium on the "Principles of Practice in Periodontia."

field of modern dentistry, provided dentistry does not consist of filling so many teeth and bridges at so much a sitting. The need of an examination chart indicates at once a realization of the fact that an examination of the mouth should be at least systematic, if not thorough.

In a case in which a large amount of reconstructive work is indicated, what are those things that we should know? We look in the mouth and see that certain teeth are missing; that there are crowns and bridges; some discolored teeth; some loose teeth, some with fillings in varying stages of preservation, and some that are apparently normal. The crowns of teeth show certain conditions that we can easily understand and evaluate, but how about the roots and alveolar process? There are a few who still claim to be able to tell all about such conditions without the aid of the roentgen ray. There used to be phenomenal individuals who could, or thought they could, open and fill all root canals to the end. Experience has taught us that such achievements exist entirely in the mind and that, in reality, they could do no such a thing.

Therefore, our first requisite, in a survey, is the full-mouth roentgen-ray examination. This should always constitute a part of the examination; for by what it reveals we determine what we should do. In its absence, we grope blindly in the dark. From such an examination, we gather fairly accurate information about the conditions around the roots of the teeth. We can determine the extent of the alveolar involvement around the sides of the teeth; the condition of the apical tissues, root canal fillings and the alveolar crest; the presence of buried roots, and unerupted teeth, and many other conditions of importance.

Following this, there should be a vitality test of all the teeth to determine which, if any, of the pulps have lost their vitality, and when such conditions do not show in the radiogram, impressions taken in modeling compound are secured, from which study casts are made. With these before us, we are able to sit down at our leisure and study the case. With the patient in the chair, and with good illumination, we study each tooth and decide what its condition is and what its requirements are. These are entered on the chart for purposes of study and diagnosis.

With a reasonable amount of information as to the physical well-being of the patient, we are ready to proceed with the analysis of the case.

The practice of dentistry is logically divided into two branches, equally important and vitally interdependent: stomatology and restorative dental operations. The latter is dependent on the former, and the successful application of stomatology depends on our knowledge of the general health of the patient. While it must be admitted that the word "stomatology" hardly defines nonmechanical dentistry, it seems to be the most descriptive word available today. Hence, the successful practice of dentistry means:

1. That one must be able to obtain information from the patient concerning what, perchance, may be vital, general conditions as well as local conditions, and, having obtained such information, must know how to act on it.

2. One must understand how to make an oral examination that is sufficiently searching in its character that all conditions of importance to the dentist are brought under consideration. When

all of the information obtained by the oral examination has been carefully reviewed, one may arrive at a more accurate diagnosis. Our conclusions in this connection are reached as the result of past experience, a knowledge of what has been observed by others and a judicial analysis of the information obtained.

3. The first operative procedure should be to put the mouth in a healthy condition. This should be done before any restorative work is undertaken.

4. The case then must receive the attention it merits from the standpoint of the designing of the restorative operations. The restorative operations so planned must be carefully and painstakingly carried out.

5. Arrangements must be made whereby the patient's mouth, by routine oral prophylaxis, supervision and instruction by the stomatologist, will be kept in a healthy condition and not permitted to again become the seat of diseased processes.

The first three and last problems, grouped under the general head of stomatology, as distinguished from restorative dental operations, are handled as follows:

### ORAL DIAGNOSIS CHART

In most cases, the patient will have some definite or specific trouble or complaint for which he seeks relief. This condition is noted, whatever it may be, and as described by the patient. On the chart, this is entered after "Complaint." Next is recorded the general condition of the mouth. This is a brief comment regarding the manner in which the patient keeps his mouth, the condition of the mucosa and the quality of the restorative work present.

There are certain important conditions that one should observe and record concerning each tooth and its contiguous tissues. These are recorded in the following order and in the column provided for them. Unless otherwise provided for, the normal conditions are recorded by a dot *(.)* and the degree of departure from the normal is indicated by *1, 2, 3* and *4*. Our findings are divided into two general classes: clinical findings and radiographic findings.

### CLINICAL FINDINGS

Gingiva: Here we record the normal, abnormal or diseased conditions of the gingival tissue. Such conditions as atrophy (recession of the gums), hypertrophy and normal conditions are noted. Atrophy is recorded as *At*; hypertrophy, *Hy;* and normal *(.)*. Any teeth missing are indicated by *A* (absent) in this column.

Caries: Here one records the extent and location of caries as found by clinical examination. The surface or surfaces of the tooth on which it occurs is noted; e.g., *M*, mesial; *B*, buccal; *D*, distal; *L*, lingual and *O*, occlusal. If occurring at the gingival, the letter *G* is added, e.g., *B.G.*, a cavity at the gingival border on the buccal surface.

Caries; roentgen ray: It is frequently quite impossible to detect dental caries in its early stages when it is developing on the proximal surfaces with the proximating teeth in place. This column is filled in from the radiograms subsequent to the recording of the clinical examination. It was felt that it should be placed between the columns of the clinical findings assigned to caries and to restorations in order that the entire record of dental caries might be determined at a glance. When caries is seen at the gingival margin of a restoration, it may be graphically indicated without confusion by drawing an arrow

from caries in the roentgen-ray column to the restoration listed in the adjoining column.

Restorations: The influence that mechanical restorations have on the tissues of the mouth is so marked that note is made of their quality. In deciding this, we must consider restoration of form and function, and also adaptation. The hygienic possibilities are also observed. We also record the type of restoration; e.g., a mesiocclusal gold inlay is recorded *MO Gi*; distocclusal amalgam, *DO Am*; gold crown, *G. Crn*; dowel crown, *Dl. Crn*, etc.

Traumatic occlusion: A careful study is made of each tooth in occlusion and in forward and lateral movements of the mandible as in mastication. If it is found that any teeth bear an inharmonious relation to teeth in the opposing jaw, to the extent that excessive stress is exerted, such condition is noted: *(.)* normal; *T.O.*, traumatic occlusion, and *N.O.*, nonocclusion (open bite).

Mobility: Each tooth has a natural range of mobility, limited or determined by a normal tooth socket and pericemental membrane. This must be recognized as normal. When, on careful palpation, the tooth exceeds its normal mobility, the degree of movement is recorded.

Vitality: Frequently, it will be found that pulps have lost their vitality without such a condition being manifest in the radiogram. For this reason, we test each tooth with a faradic battery to ascertain its vitality. In this connection, it must be remembered that, under certain conditions, we use other agents to determine tooth vitality, but, as a general rule, the faradic battery is sufficient. The vitality is recorded for vital and for pulpless teeth.

Contact points: As the relation that adjacent teeth bear to each other through their contact points has a most important influence on the interproximal tissue, it is necessary that we record the quality or nature of the contact point. In this connection, the mesial contact of each tooth is assigned to that tooth. Contact points are recorded: *F*, flat; *O*, open; *(.)* normal.

The above mentioned conditions, with the exception of "Caries; *roentgen ray*," are included in what are termed the "clinical findings," and are observed by a careful survey of the mouth.

### RADIOGRAPHIC FINDINGS

A complete or full-mouth roentgen-ray examination, carefully standardized, is made, and the films are mounted together and studied. The following points are noted:

Pulp chamber and canals: The absence or presence of concretions, such as pulp nodules and secondary dentin in the pulp chambers and canals, and abnormality in the shape of the chamber or canals are noted. In case root-canal operations have been carried out, the apparent success of such operations, viewed from a mechanical standpoint, is recorded. Secondary dentin is indicated by *S.D.*; pulp nodules, by *P.N.*; root canal operations, by *R.C.O.*

Pericemental membrane: In accurate oral radiography, close attention is paid to the pericemental membrane. Early pathologic change makes its appearance in a thickening of the fine line representing the pericemental membrane.

Pericemental lamella: The study of the pericemental lamella is only possible with radiograms of fine definition. It is a fact worthy of note that it is the condition of the pericemental lamella or dense layer of bone surrounding the pericemental membrane that determines

what is occurring around pulpless teeth, and not the absence or presence of guttapercha or other foreign material in the canals. This has been too frequently overlooked. The pericemental lamella should be shown distinctly in the radiogram in order that any increased deposit of calcium may be observed. Whether any break or bulging has occurred indicating the presence and activity of a diseased process should also be shown.

Crest: Atrophy of the alveolar crest is a most important manifestation of pericementoclasia (pyorrhea alveolaris), and it is important that its presence be known early in order that the causes contributing to such a condition be detected, recognized and eliminated if possible. Involvement of the buccal and lingual crest should not be overlooked.

Bifurcation: Atrophy of the alveolar process at the bifurcation of lower molar roots is an indication of a serious condition, most difficult to control if allowed to develop. As a rule, our only hope of success in handling these cases lies in the early treatment of the cause.

Apical circumscribed atrophy: A circumscribed apical atrophy generally means a condition of long standing. The condition is identified by the clear-cut outline of condensed bone surrounding the granuloma or abscess. The size of the area is noted.

Apical diffuse atrophy: A diffused apical atrophy is generally an indication of a more recent infection and is at times difficult to detect. It is identified many times by comparison with the adjacent alveolar process.

Alveolar hypertrophy: One of the early indications of the presence of an irritant, such as traumatic occlusion, is an increase in the calcium content in the alveolar process at certain points. This is seen as a daub of white (Pollia) in the field of the alveolar process due to an increase of calcium salts, and its location indicates the direction from which the excessive stress is coming. In view of the fact that this condition, if allowed to develop, will probably result in the loss of the tooth, the importance of detecting it in the early stage is apparent. This point is significant in considering the benefit of repeated radiographic examinations of the teeth and alveolar process. The location, mesial or distal to the root, is noted. It must not be overlooked that lingual or buccal hypertrophy may occur, but is difficult to interpret.

### TREATMENT AND OPERATIONS INDICATED

Stomatology: In this column are recorded all operations and treatments coming under the general classification of "the removal of diseased oral conditions." They consist of periodontia; root-canal operations; extractions and removal of infected periapical tissues, and treatment of infected dentin in cases of extensive caries in vital teeth. The extent of the operations necessary in a given case of pericementoclasia is recorded after the word periodontia (*1*, *2*, *3*, or *4*).

Dental restorations: Here are recorded all operations, such as fillings, crowns, bridges, etc., that are necessary in restoring function.

At the bottom of the page, a summary is made of all the operations, examination, etc., as a means of ascertaining the extent of work necessary, fees, etc.

### CASE RECORD

At the top of pages 2 and 3, we record the patient's age, weight, nor-

mal and present, the name of his physician and by whom he was referred. The rest of the page is devoted to case history, findings, diagnosis, treatment and progress notes.

CASE HISTORY

In obtaining a patient's history, it is by no means intended that the dentist supplant the internist in any sense, but it must be borne in mind that we must ever practice dentistry from the standpoint of the patient's health, and in order that we may know whether or not the patient enjoys normal good health, it is necessary that we do more than casually inquire, "How do you feel?"

At the same time, the possibility that the patient might easily get the impression that we are invading other fields than our own must be kept in mind in obtaining a history. We can logically begin in what is distinctly our own field by making an inquiry into mouth conditions, proceeding with the idea that we are seeking evidences of infection possibly having its origin in the mouth and making itself felt in other parts of the body. The following order is observed:

Pulpitis; devitalization: Inquiry is made as to whether any of the teeth are now or have been sensitive to heat or cold; also what information the patient can give as to devitalization of pulps. (As a general rule, this will reveal the fact that most pulps were unnecessarily devitalized on account of extensive caries.) Herein lies the solution to most of the root-canal problems.

Apical infection: Question the patient carefully as to evidences of apical infection; e.g., teeth uncomfortable, face swollen, pus discharging on the gums and teeth treated. At this point, do not overlook the importance of recording any teeth having been extracted on account of apical infection.

Pericementoclasia: In case the patient has been treated for pericementoclasia (pyorrhea alveolaris), the time, nature and extent of such treatment is recorded.

Orthodontic treatment: Work that has been done in correcting any irregularity of the teeth is noted.

NOSE, THROAT AND EAR HISTORY

Nose and throat conditions may be secondary to or associated with mouth conditions. Inquire as to recurrent chronic or acute attacks of tonsillitis, also as to any history of pharyngitis or laryngitis. Note the presence of enlarged glands of the neck. Obtain any information as to diseases of the middle ear, if the patient experiences any buzzing in the ears or has impaired hearing, or if there has been any discharge from the ears.

Maxillary sinusitis: Antrum disease may be due to an extension of dento-alveolar disease, and we should, especially in cases of pulpless upper molars and bicuspids, question the patient closely for symptoms indicating antral infection, such as nasal obstruction, purulent unilateral or bilateral discharge, either anteriorly or into the nasopharynx, pain in the frontal region or pain in the region of the antra.

Trifacial neuralgia: All information as to the character of the pain, incidence, location and duration is recorded.

Headache: Continued headache is indicative of various conditions, some quite serious, and, in case a patient gives such a history, it is well to refer him to his physician for an examination.

Eye conditions: Here, we record any

tendency to impairment of vision or any occurrence of inflammation or pain.

General history: We inquire as to the patient's strength and endurance at the present time as compared with his condition a few years previous, special interest being centered on lack of strength in the afternoon. The character of sleep is noted.

Rheumatism: The occurrence of any attack of rheumatism within the memory of the patient, involving muscles or joints, is noted. Also, we further inquire as to pain, soreness, stiffness or swelling at the present time in any of the joints. Its duration and location are made note of.

Habits of mastication; gastro-intestinal history: Record is made as to whether the patient eats his meals slowly or rapidly; also as to whether the appetite is normal. Inquire into any pain or discomfort the patient may experience after eating. This may reveal a gastric ulcer or other serious gastro-intestinal conditions developing, and it is of great importance that they be not overlooked. Any tendency to constipation is recorded. Note is here made of the daily liquid intake. At times, it will be found that the liquid intake is quite inadequate; while, at other times, a great deal of water is consumed, a possible diabetic condition being indicated.

Heart and kidney condition: Inquiry is made as to whether the patient has ever had a diagnosis made of heart or kidney disease and whether any symptoms referable to these organs are present.

Blood conditions: Inquiry is made as to any tendency to anemia and as to whether the patient bleeds excessively from minor cuts, an indication that he may be a hemophiliac (bleeder).

Nervous conditions: Any disturbed condition of the nervous system of which the patient may be cognizant is noted.

When this history is obtained, the dentist is in a position to proceed more intelligently with operations to be performed in the mouth. Further, he may find it to his and the patient's advantage that the patient be referred to his physician before anything is done with mouth conditions.

### ORAL PROPHYLAXIS CHART

A real tangible step in reaching the goal of preventive medicine is made by the adoption and use of the oral prophylaxis chart. It means that prophylactic dentistry is here, and here to stay. This work is pleasing, inspiring and gratifying. The chart serves as a guide in establishing and maintaining a condition in the human mouth wherein disease will not prevail. The mouths of patients receiving this attention are distinctive in their beauty. This is the definite goal toward which we must strive.

From time to time, definite instructions are given to patients regarding the home care of the mouth. Lines for eighteen separate appointments are provided under "instruction in home care of the mouth." The information secured at the initial examination and recorded on the top line after "examination" is secured at each subsequent visit and recorded on lines 1 to 27.

Patients are seen at one, two or three month intervals, and their attention is drawn to areas not under perfect control by the patient in order that they may concentrate on them, thereby further raising the general tone of the mouth, until an almost inconceivable condition of oral health is reached.

This, of course, implies that proper restorative operations must be performed.

Presence of food around the teeth: It is the intention here to record the extent to which food is packed around the teeth. This gives us a good clue to the care the patient gives to the brushing of the teeth. It also is generally to be taken as an indication of the extent to which we may expect dental caries and gingivoperidental infection.

Calculus: Here, we record the extent to which we see calculus adhering to the teeth. This condition reveals quite plainly the care the patient is giving the mouth, the habits of mastication, and also, in certain instances, is an index to improper diet.

Stain: There are different types of stain found on the human teeth. The presence of such is recorded. It is an obvious fact that patients will not take pride in their teeth if they are badly stained. In consonance with this thought, patients are carefully instructed in keeping the teeth free from stain by home care. To attempt to keep the teeth free from stain solely by visits to the dentist is futile.

Suppuration: One frequently encounters mouths in which there is considerable "open infection" (pus draining into the mouth from so-called pyorrhea pockets). Record is made of the extent to which such a condition exists.

Erosion: Note is made of the extent to which we find erosion and whether it is of a mechanical or chemical nature. All these conditions are recorded *(.)*, *1*, *2*, *3* and *4*, as previously explained.

New cavities (indicated by the number of cavities): In order that we may know the progress made in controlling dental caries, record should be made of the development of new cavities, as revealed clinically or by our routine roentgen-ray examination. Also, in order that the conditions influencing the incidence of decay on various surfaces may be recognized, the surfaces on which the decay occurs are noted.

Saliva: Any information desired relative to the saliva, as to quantity and consistence, may be recorded. When special tests are made, the findings are recorded on page 2 of the chart.

This completes the record of conditions of importance found in the mouth, and the extent to which disease is controlled will furnish the index as to the progress we are making in the care of the mouth.

Tooth brushing: There are in common use so many different ways of brushing the teeth that it must not be assumed that, simply because a patient "brushes his teeth," they are brushed effectively. In doing this work, the patients must understand that they have a definite, specific function to perform and that, in maintaining a condition of oral health, success is only possible with their cooperation. By observing the patients brush their teeth in the operating room, the manner and efficiency is easily ascertained and recorded. The attention of the patient is drawn to neglected areas, which are further demonstrated by the use of the disclosing solution.

Use of dental floss (record frequency): Dental floss has an important place in the mouth toilet, but injudicious use may injure the teeth or gums.

Dentifrice: Here is indicated the dentifrice used by the patient.

Mouthwash: The name of any mouthwash used by the patient is recorded.

Diet: From a description of the

meals of an average day, the amount of sugar, starch, protein, fat and fruit eaten is recorded. The figure *2* is used to denote what would be considered an average consumption of the various components of the diet, excessive consumption is denoted by *3-4*, diminished amount by *1-0*.

Beverages: It is most important to know and record the average daily fluid intake and of what it consists.

Habits: Note is made as to whether or not the patient's daily mode of living is sedentary or active.

Tobacco: It is of importance to know the extent to which tobacco is used. This is here recorded.

All of this information is secured from the patient at the initial examination, and, from time to time, at the regular appointments, progress notes are made of any changes in conditions, habits, etc. In this way, control is finally secured of the conditions in the mouth, and we can then maintain the health of the oral cavity.

The chart of the teeth may be used to record the location of fillings, crowns and bridges present when the examination is made and the position of new cavities, or any special diagrams that may be of interest.

As the result of an extensive study and analysis of the ideal and practical, it has been found that the following difficulties have to be overcome:

1. It is foolish to expect a dental hygienist to understand conditions in the mouth that requires years of study by the dentist.

2. The dentist, already busy with restorative dentistry, has not time to do routine prophylactic work.

The following compromise is effected: The carefully trained and qualified hygienist does the bulk of the polishing of the teeth; the dentist records the conditions found and, in addition, goes over the mouth thoroughly at least once each year. It would assist very materially in accomplishing the ideal if periodontists would cooperate in this work and develop their practice along these lines.

A careful analysis of the literature of the past two years reveals the fact that the practice of dentistry is undergoing many changes. It can no longer be practiced as a thing apart from other branches of medical science. That time will soon be past when the majority of practicing dentists will confine practically their entire attention and effort to the restoration of tooth structure. Countless patients are still being treated from this lamentable standpoint and, on the completion of dental restorative work, are dismissed, with the impression that their mouths are in a healthy condition and will remain so for a reasonable period of time. One sees, day after day, patients for whom recent excellent restorative work has been done in mouths presenting a well-established gingivoperidental infection. A large number of these patients are unconscious of the condition and frequently state that "Dr. So-and-So just finished my dental work three or four months ago and told me that my mouth was in an excellent condition."

Thanks to the roentgen ray, the practice of placing dental restorations on teeth showing marked dento-alveolar infection is becoming less frequent; a most hopeful sign.

The fact that a patient comes in to have a certain tooth filled does not absolve the dentist from his manifest duty to point out (1) the presence of disease of the investing tissues of the teeth; (2) the untoward effects of such infec-

tions, and (3) the individual's right to possess a clean, healthy mouth.

Wherein lies the solution of the present problems? Obviously, efficient treatment must be based upon complete and thorough diagnosis. The latter is dependent on systematic and carefully made examinations and case records. This has been amply proved in all branches of medicine and surgery in both hospital and private practice.

A casual survey of the chart might lead one to believe that such an examination and its recording would consume a considerable amount of time. Such is not the case. Much time can be conserved by standardizing the method of securing a history and making a clinical examination. One dictates direct to the dental assistant, who records the clinical findings on page 1 on the chart. The clinical examination requires from twenty to thirty minutes; the taking of impressions for study casts, about ten minutes, and the making of fifteen roentgen-ray exposures, from twenty to thirty minutes. The examination and interpretation of the films, including the record of the findings, take from ten to fifteen minutes. The clinical and radiographic findings may then be rapidly correlated, a diagnosis made, the treatment and operations indicated and recorded on the chart. A general résumé of the diagnosis and treatment outlined is dictated for insertion on page 2, following the history. This requires about ten minutes additional time. The total time, exclusive of the presentation of the diagnosis and plan of treatment to the patient, thus consumes about ninety or 100 minutes (exclusive of the assistant's time in developing and mounting the films and pouring and making the study casts).

The pleasure and personal satisfaction of conducting a practice along systematic lines is more than can be computed. The knowledge that no stone has been left unturned in obtaining greater knowledge regarding the condition of the teeth and their investing tissues gives one the assurance that the diagnosis is correct, and that the plan of treatment is logical. With this in mind, we can, with utmost confidence in the outcome, proceed with the treatment of the case according to plan.

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# IMPORTANT FACTORS IN THE ETIOLOGY AND CONTROL OF PERIODONTOCLASIA*

By THOMAS BRADFORD HARTZELL, M.D., D.M.D., F.A.C.D.,
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THE etiologic factors of that type of periodontoclasia commonly called pyorrhea alveolaris are very simple. We have, first, all of those factors that tend to break down the normal resistance of the tissues to the invasion of pyogenic bacteria. These are legion, and because of the fact that superficial investigators in clinical lines have noticed that correction of malocclusion or a dietetic change has resulted in the cure

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of a case of pyorrhea, they have confidently stated that the cause of the condition is this or that particular factor which they have noticed and have had the fortune to eliminate, not recognizing the fact that they have merely increased tissue resistance by removing a handicap.

I have conclusively shown that pyorrhea cannot exist without pyogenic bacteria; that individuals may be on the worst possible diet and, notwithstanding, if the necks of the teeth adjacent to the soft tissues are kept sufficiently free from bacteria, and the soft tissues are daily stimulated by friction and pressure, no periodontoclasia, or pyorrhea, can exist.

I have conclusively shown[1] that force in mastication may be very unevenly applied in all sorts of conditions, in almost any direction, in old people or in young, and notwithstanding these conditions of incorrect application of force on teeth in the act of mastication, such teeth do not develop pyorrhea if they are kept scrupulously clean at the junction of the soft tissue with the hard, and, in addition, the soft tissues receive proper stimulation by friction and pressure.

The submucous connective tissues of the gums are capable of being increased in density, in circulation and in bulk, and the same is true of the epithelium. The epithelium of the gums obeys the same laws and responds to the same influence as does the epithelium covering the palms or the soles; namely, it may be increased greatly in thickness, in bulk and in density by use, thereby increasing its power of resistance to invasion by bacteria.

1. Hartzell, T. B.: Etiology of Pyorrhea Alveolaris, with a Simplified Treatment, J.A.D.A., 12: 1452 (Dec.) 1925.

Periodontoclasia can occur without the presence of bacteria. The orthodontist constantly takes advantage of this fact, and thus moves the teeth of the young, and sometimes of the old, through considerable areas of bony space by causing pressure absorption to occur. The orthodontist secures this movement of teeth through the bone as the result of the application of force, and, if conditions of mouth and tooth-neck cleanliness are normally maintained, need never permit infection to cause pyorrhea. In fact, even with the increased difficulty of keeping the teeth clean because of the presence of regulating appliances, it seldom does cause pyorrhea.

The resistance of the human family to pyogenic cocci is normally great. The building of such resistance begins in babyhood. Although the mouth of the baby is sterile at birth, both streptococci and staphylococci gain access to the mouth almost immediately after birth and live on, and sometimes in, the mouth tissues from that time on until death. It is a notable fact that a few individuals go through a long life with little or no evidence of invasion by pyogenic bacteria. The more or less constant presence of these organisms in the mouth and on the tissues of the nasal mucous membrane, and their abundant presence in the intestines, seems to act as an antigen, thus slowly increasing resistance to their invasive power. Were it not for the development of power to inhibit, in some measure, the growth and invasion of these pyogenic bacteria, which, unresisted, double in number every thirty-five minutes, the life span of us all would be greatly shortened.

The direct destruction and loss of the epithelium guarding the gingival crev-

ice, and the dissolution of the fibers that unite the tooth root to the socket, are due only to bacteria present, being caused by the action of their ferments and toxins. Without bacteria, no pus can be formed.

That type of periodontoclasia characterized by pyorrhea can be prevented and cured in every instance in which we can control the growth and invasion of these pyogenic organisms. The characteristic tissue reaction to the invasion of it by streptococci is a metaplastic fibrosis, no matter where the streptococcus is introduced in the tissue. When in the glomerulus of the kidney, we see it as a crescent of scar tissue. In the tubules of the kidney, they cause to be produced an increased amount of interstitial connective tissue, as seen in true Bright's disease (interstitial nephritis). In the heart muscle, we have the formation of Aschoff bodies and, subsequently, scar or fibrous tissue. If it be about a root end, we have a granulomatous mass of fibrous tissue taking the place of the destroyed bony tissue. This granulomatous tissue, subsequently, in many instances, becomes a prey to the activity of staphylococci, which dissolve it, forming true pus, beginning as a little cystlike mass in the center of the granuloma and subsequently breaking down the bulk of it, leaving only a sacklike fibrous tissue membrane about its periphery.

The same reaction is seen in the area penetrated by streptococci around teeth. Box has called attention to this development of fibrous tissue. Llewellyn and Jones[2] have written a 600 page book on fibrositis in which they discuss the causes and meaning of the great increase of fibrous tissue in rheumatism of joints and muscles. They show the character of this pathologic hyperplasia in both joints and muscles, and discuss the relation of infectious micro-organisms to this hyperplastic increase of fibrous tissue in the several areas involved.

I point out these facts regarding the pathologic reaction of the tissue to the invasion of the streptococcus because it is not generally recognized, and many men, particularly Box, are making wrong deductions from what they see. One other marked and characteristic blood cell reaction to the streptococcus is that, in all those types of streptococci of low grade virulence, of which viridans is an example, the blood cell outpour is plasma cells and lymphocytes. For the past ten years, in examining histologic preparations from any part of the body, I have come to rely on this characteristic as distinctly indicating the presence of streptococci in the area, even though the tissue is not stained to reveal their presence in it.

As staphylococci gain in number, the the number of polymorphonuclear leukocytes increase. The polymorphonuclear leukocytes are always present with the plasma cells and lymphocytes in purely streptococcal infections, but not in such great numbers as we find them where the staphylococcus is also at work.

The streptococcus is the first and principal invader. Its powerful invasive ability has been noticed by many observers. It dissolves the enamel through the action of its acids, and invades the tubules of dentin and the pulps of teeth, as was pointed out by Seberth, Kantorowitz, Goadby, Henrici, Black and me. Its virulence or power to

2. Llewellyn, L. T., and Jones, A. B.: Fibrositis, Gouty, Infective, Traumatic. New York, Rebman and Company.

work can be vastly increased in the presence of proper mediums, as has been pointed out by Larson, who shows that the virulence of staphylococci can be increased tremendously by growing it in mediums favorable to the development of much fat. He has shown that the fat content of the membrane of the staphylococcus can be increased as much as 700 per cent, and its resistance to the action of the body fluids thereby is increased to a point that makes it a tremendous death dealer because of the incapability of the defensive juices of the body to penetrate its fatty coat.

These two pyogenic bacteria, the streptococcus and the staphylococcus, are together the principal elements in the causation of that type of periodontoclasia in which we have pyorrhea. Henrici and I[3] have shown the penetrating power of streptococcus into both soft tissue and bone, finding them in 150 out of 160 root ends examined. We have pointed out that, in the case of the tooth-root infections, streptococci may even be found in the apparently normal tissue two or three teeth removed from the focus of infection. I have demonstrated their presence in the tissues,[1] and published sections showing stained bacteria in the tissues far removed from the ulcerating surface of pyorrhea pockets. I have shown also that if the portion of the tooth adjacent to the soft tissue is kept thoroughly scoured by inserting the toothbrush bristles between the teeth, using force to wedge them so that a short movement of the handle causes the sides of the bristles to scour the sides of the tooth, shallow pyorrhea pockets heal rapidly.

I have also shown that the epithelium guarding the sides of the pockets may be greatly increased by the back and forth friction of the toothbrush bristles against the mucous membrane guarding the tissue between and around the teeth; which so increases the resistance of the tissues to invasion that few bacteria enter and the sores heal rapidly, this demonstrating the fact that a pyogenic bacterium causes these lesions. I have further called attention to the fact that as soon as teeth suffering from pyorrhea are removed, the gums rapidly heal because there is no longer a sufficient amount of ferment present to continue to dissolve the tissue.

I have further demonstrated the fact that the mucous membrane can be made to reach to the bottoms of all pyorrhea pockets that are not more than double the depth of the normal gingival crevice; that where sores have attained a much greater depth than that, I can, by the reduction of the depth of the pocket by cutting away part of it with the knife, or destroying the upper edges of the pockets by the use of an escharotic, following that with astringent applications and friction, so shrink the tissues that all pyorrhea pockets will heal to the very bottom of the original sore, no matter how deep that lesion might have been.

These are statements of facts many times demonstrated, and which cannot be controverted. The discovery by Larson[4] of sodium ricinoleate, in 1919, a substance which has power to neutralize bacterial toxins and kill streptococci also, has been a great step forward in the treatment of pyorrheal periodontoclasia, in that we can neutral-

3. Hartzell, T. B., and Henrici, A. T.: J.A.M.A., 1915.

4. Larson, W. P.: Preparation of Pure Sodium Ricinoleate, Proc. Soc. Exper. Biol. & Med., 22: 553 (May) 1925.

ize bacterial toxins with it, making them harmless, and being enabled to get control of them by destroying the streptococci themselves wherever we can make contact with them. Its use in any soluble calcium-free combination of not to exceed 2 per cent, in either liquid or semisolid mouth or tooth cleansing preparations, not only neutralizes all bacterial ferments and toxins and destroys the streptococci, but also is harmless to the tissue cells.

The intelligent application of these facts places the control of this disease easily within our grasp.

CONCLUSION

1. All those factors that tend to break down resistance to bacterial invasion, i. e., malocclusion, improper foods, etc., should be eliminated.

2. Resistance to bacterial invasion should be increased by correct foods and water intake.

3. The depths of all pockets already formed should be reduced to a depth that will permit the epithelium to penetrate to the bottom of the gingival crevice.

4. The necks of the teeth should be kept sufficiently free from pyogenic cocci that there cannot be enough ferment produced to attack the tissues.

5. The vitality, bulk and density of the gums should be increased by friction and physical exercise.

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# AIMS AND RESULTS OF PERIODONTAL TREATMENT*

By AUSTIN F. JAMES, D.D.S., Chicago, Illinois

A SHORT symposium on the aims and results of periodontal treatment can no more than declare that the advocates of preventive measures, and those treating actually diseased gingival conditions, have not been practicing a hobby; but have developed definite scientific methods that have established, beyond question, the necessity of early recognition and skilful removal of all forms of irritation of the gingival tissues.

Enthusiastic, comprehensive teaching will result in the prevention of serious caries of the teeth as well as the infection of their supporting structures. The dentists who have specialized in the practice of prophylaxis and the treatment of infections in the mouth have been earnest and untiring workers. They have readily cooperated with each other in the exchange of thoughts and methods in specially organized society work, until they have established themselves as a legitimate and needful factor in the dental profession.

For many years, certain practitioners have devoted themselves to this phase of the dental problem and have become known nationally as authorities on the practical principles of this specialty. Some of our most successful investigators of the effects of deficient diet and faulty metabolism on the teeth and their supporting structures, and correction of these disturbances, have been practitioners of this special branch of dentistry.

*Read before the Section on Periodontia at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

The periodontist has many opportunities to recognize deficiencies in diet and to teach their correction, long before the patient comes under the observation of a physician. Modern ways of living and lack of function in the mastication of civilized foods have their effect on the teeth and their investing tissues. It has become the province of the periodontist to devise means of combating the effects of this lack of use, by teaching general mouth hygiene and proper use of the toothbrush, which will result in the building up of tissue cell resistance. The periodontist has also been the first to call attention to, and devise a means of relieving, occlusal trauma in natural teeth, a condition also resulting from lack of function. If the teeth were used as Nature intended, the cusps would be worn down in the act of milling food. This compensating wear would be even enough, and the stimulating effect great enough, to prevent the result which comes from occlusal trauma. The practitioners of periodontia have studied the bacterial floras of the mouth and have established the fact that, whenever gingival inflammation is present, or acute infection established, streptococci are the predominating organisms, and they are growing in sufficient numbers to attack the tissue cells. After the destruction of these cells, when the chronic stage of infection has been reached, the staphlococci take possession and become the pus-forming organisms in all these areas of low-grade mild forms of infection.

To the periodontist, the problem of infection in the mouth has simply become one of getting rid of the places that harbor bacteria in sufficient numbers to attack tissue cells. When this has been accomplished and the patient has been taught how to maintain this result, there need be no further fear of gingival infections.

The principles of the periodontist in practice are (1) to assume the responsibility of removing all forms of irritation from the mouth; (2) to put all tooth surfaces in such condition that the patient may be able to keep the mouth and teeth in a hygienic condition, and (3) to teach the patient how to maintain this result.

There is no doubt that the practical application of these principles brings more definite success in its results than anything that can be accomplished in dentistry.

# THE PRINCIPLES OF PRACTICE IN PERIODONTIA WITH SPECIAL REFERENCE TO THE SEQUENCE OF STEPS IN TREATMENT*

By M. H. GARVIN, D.D.S., Winnipeg, Canada

IN the successful practice of periodontia, the sequence of steps in treatment is of vital importance. How often have we seen certain treatment for periodontoclasia commenced and even continued without a thorough diagnosis of the mouth condition having been made. How often, for instance, have we seen a bridge inserted on one

*Read before the Section on Periodontia at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

side of the mouth without careful consideration of the teeth on the other side, with the result that, within a few months, a pathologic condition, which may have existed at the time of the first examination, has developed, involving the loss of certain teeth, and the necessity for a denture; in which case the bridge already inserted is probably lost. Again, we have frequently seen beautiful restorations placed on pulpless teeth that may have looked normal radiographically, and without any effort to obtain either the personal or family history; with the result that, a little later, the patient has perhaps developed an acute endocarditis, which means the loss of these teeth, together with the restoration. Also, we frequently see treatment for periodontoclasia undertaken without consideration of the patient's habits of diet, exercise, etc., and perhaps find later that this patient is continually breaking all the laws of God and of man. Often we have seen periodontal treatment in the nature of thorough apoxesis undertaken or even the employment of radical surgery of the periodontal tissues without cognizance being taken of a pronounced traumatic occlusion.

We can readily see, from these and many similar illustrations, that the sequence of steps in treatment must receive the earnest consideration of every periodontist.

For obvious reasons, all cases cannot be treated alike. In one case, uncleanliness seems to be of paramount importance; in another, traumatic occlusion; and, again, we find that the lack of tone of the tissues themselves seems to prevent the cell activity necessary for a normal mouth condition. The periodontist is a diagnostician in the broadest sense, not only having to diagnose and correct disease of the periodontal tissues but, in addition, having to prescribe suitable restorations, so that normal function and freedom from irritation will exist. It is therefore apparent that if the periodontist intends to limit his practice to this particular specialty, he must enjoy close cooperation with a group of particularly efficient general practitioners or have the opportunity of associating himself with a group clinic of high order.

In the practice of periodontia, the patient should usually be given a thorough prophylatic treatment before a complete examination. This can be most profitably taken care of by a hygienist. Some direction as to mouth toilet should be given at this time; which can also be explained by the hygienist. The service that an intelligent and well-trained hygienist can render in preparing the patient for further examination is of real value, and is also one more step toward bringing modern dental service within the financial reach of an ever-increasing number of needy patients.

The teeth should now be examined for vitality, thermal or electric tests or transillumination being used, as may be necessary, to insure a correct conclusion as to the condition of the pulp. As a rule, a complete set of radiograms should be taken in order to check up pulpless teeth, the depth of the periodontoclasia pockets, residual granulomas, root fragments, impacted and supernumerary teeth and all other pathologic conditions.

Study casts should be obtained when advisable and mounted on an anatomic articulator.

One is now in a position to continue the examination, which should be

thorough, being of paramount importance. Failure to understand the etiology, the prognosis and the proper method of treatment will surely lead to disappointment.

We should now proceed with a careful clinical examination of the teeth and periodontium, noting the nature of the occlusion, observing the teeth in function, testing for mobility, noting anatomic irregularities of position and form, recording all caries, exposed pulps, defective contacts, erosion, abrasion and imperfect restorations of every kind, also the nature of the deposit and the pus that may be present. One should emphasize the importance of obtaining from the patient at this time an adequate family and personal history. The nature of the history so often determines the type of treatment. D. J. McCarty,[1] of Philadelphia says: "Does the dentist ever say: 'Tell me about your health? What diseases have you had? Have you had any attacks of tonsillitis or rheumatism? Have you had any heart disease?' The dentist who will not take a history of the case is in the same position as the medical practitioner who prescribes for the patient without getting his history." A carefully prepared history is of great value in the successful practice of periodontia.

Before proceeding to complete the diagnosis, a bacteriologic study of the periodontoclasia pockets would prove interesting as well as profitable from the standpoint of treatment. We would question the importance of the statement, so often made, that periodontoclasia can exist only as the result of the presence of the streptococcus and staphylococcus. We believe that the future will show that the spirochete plays a much greater rôle in the pathology of this disease than it has been given credit for. A study of these organisms under the dark-field illuminator or with a stained specimen, using the Warthin or Fontana method, will convince one that they are not to be lightly passed over in a study of the bacteriology of periodontoclasia.

Having examined the study casts and radiograms, and having perused carefully the clinical findings, one is in a position to make a diagnosis. In this connection, one great problem will be the attitude to be taken toward the pulpless tooth. For some time, we have been using as a working hypothesis, pending further investigation, a plan that is briefly as follows: Those patients with a good family and personal history, we place in Group 1, and allow pulpless teeth which are radiographically normal to remain until 60 years of age or later. Those patients who have a good family history but who have acquired a susceptibility to a streptococcus infection, we place in Group 2, and advise removing pulpless teeth after 40 or 45 years of age. Those patients with a poor family and personal history, we place in Group 3, and advise removing pulpless teeth at any age. On this basis we now remove pulpless teeth, at the same time realizing that teeth are useful organs and believing that the day will come when it will be possible to save more pulpless teeth rather than less. Until a more uniform opinion prevails and until more genuine research has been conducted, we feel the necessity of being as radical as we have just outlined. We have found this grouping of patients of great value in arriving

1. McCarthy, D. J.: J.A.M.A., 85: 1949-1952 (Dec. 19) 1925.

at our diagnosis, and we would express our sincere appreciation to Weston A. Price who first suggested such a grouping. The diagnosis having been made and the prognosis reasonably well established, treatment can now be proceeded with.

If systemic disease is present, it must be looked after; which may involve the cooperating service of a physician. The treatment should be commenced as soon as the physician considers it wise to do so. Often, it is not wise to institute any special systemic treatment until the grosser forms of infection are removed from the mouth. Faulty habits of work, worry, lack of exercise, etc., must be corrected. The question of diet must be considered. Percy R. Howe has shown that metabolic processes produce dental defects heretofore unsuspected, and that periodontoclasia and irregularity of the teeth have followed metabolic derangement. In these days, owing to the ease with which goods can be transported, we find a great variety of foodstuffs on our markets. As food from every part of the globe is at our disposal, we find the problem of knowing what to eat a very real one. There is a great need for information that will permit people to select foods that will produce health of mind and body. It is not within the province of this paper to discuss treatment, but, in passing, we would emphasize the importance of this phase of treatment. The periodontist should make a thorough study of this problem and be able to advise his patients within certain limits as to what foods may be taken to assist in building strong dental organs and a healthy periodontium. This advice should be given as early as possible after the diagnosis is complete.

We would now proceed with the removal of all teeth marked for extraction, with the exception, in some cases, of anterior teeth that may be temporarily kept for esthetic reasons. It calls for the removal, as soon as practical, of all other sources of local infection, with the exception of the periodontoclasia. In cases in which the systemic disorder is serious, these foci of infection should be removed slowly, often one at a time.

After the removal of these infected areas, we would stress the importance of correcting any traumatic occlusion before commencing apoxesis. Credit is particularly due Paul R. Stillman for calling attention to the importance of traumatic occlusion. Of course, it must be corrected as far as possible without mutilating the teeth if these organs are to be saved. To postpone the correction until after the apoxesis of the root surfaces means prolonging the treatment unnecessarily.

Treatment of caries and necessary root-canal operations are now begun, followed by the regular reconstructive work calling for fillings, bridges, etc. In this connection, special attention must be given to the correction of contacts and the contour of the surfaces of the teeth. In carrying out this reconstructive program, special emphasis should be placed on the necessity of producing balanced occlusion as far as this ideal is possible. When there is a lack of balance, periodontal trouble is accentuated.

Apoxesis of the root surfaces may be carried out in conjunction with the restorative work as may seem most practical. The major portion of it should be completed before much reconstructive work is undertaken. In this connection, much controversy has arisen over the necessity of surgical intervention. Sur-

gery is of great assistance in clearing up many otherwise stubborn cases. It should not be undertaken until other treatment has been given so that the gingivae may contract as much as possible and permit the removal of the smallest amount of tissue necessary to furnish free drainage. This operation, covering the field with a good surgical cement, has proved of great value in our practice. When surgical intervention is indicated, it should be completed before any extensive reconstructive work is undertaken.

Serums and vaccines are of little, if any, value, and drugs are of secondary importance in the treatment of periodontoclasia.

Massage is applied to the periodontal tissues by thorough mastication and proper brushing. The Charters method of brushing which is proving very satisfactory, should be commenced as soon as the tissue will permit thorough brushing. The patient should be carefully instructed in the method of brushing, and some test should be made to show that the technic is understood and is being practiced.

There is another step in the successful practice of periodontia that should be kept in mind during the progress of treatment, and that is the education or instruction of the patient as to the vital importance of obtaining a healthy mouth condition and of keeping it healthy. There are many ways by which this can be accomplished. One should lose no opportunity in answering questions to instruct the patient along these lines. Models, charts and photographs may be used to advantage. We would also emphasize the value of a neatly printed card that can be read at a distance of 6 feet, framed or mounted on a small stand and placed in a suitable place in the operating room, on which is printed some sentence that is striking in its educational value. It has been proved scientifically that a message is many times more effective when received through the eye than when received through the ear. It has also been proved that color is much more effective than black and white. Professional men should take more advantage of these principles than they do.

These cards can be changed from time to time. Such sentences as these can be used to advantage: "Preventive dentistry is less expensive and infinitely more valuable than reparative dentistry." "Dental prophylaxis stands today as the most practical means of controlling periodontoclasia and decay of the teeth. Careful people make it their business to have this service at least four times a year." "Unless the tissues which support the teeth are maintained in health, all else in dentistry is like a house that is built upon the sand; it cannot endure. We advise examination and prophylaxis every three months." Such thoughts kept before a patient are very helpful and are often the means of leading to a conversation of great educational value.

The apoxesis and restorative work having been completed, we are now ready for the final polishing, inspection and instruction to the patient. The importance of periodic examination and prophylaxis should be made clear, and arrangements should be made to have the patient return regularly for this service. Every three months is a fair average. In some cases, every month or two is preferable. In a few cases, every six months is not too long an interval. We are convinced that a

"prophylactic list," as we call it, is an essential to every periodontist, and that the name of every patient living within reasonable distance should be on that list and he should be telephoned or notified by card regularly for appointments. The clinical value of periodic preventive treatments of the mouth has been most ably set forth in the following summary by Dr. Hayden.[2]

A clean and sanitary condition of the mouth.

Improved health and vitality of the tissues of the mouth.

Increased mouth comfort.

Increased ability and desire to use the teeth more thoroughly.

Improved appearance of the teeth and gingivae.

Decrease of sensitiveness of the teeth and investing tissues.

Prevention of dental caries, in part or entirely.

Prevention of periodontal disease.

Prevention of systemic disease caused by oral sepsis.

Early discovery of any defects or undesirable conditions which may develop.

Better understanding by the patient of the value of a healthy mouth and its relation to general health.

Greater appreciation and demand by the patient for better dental service.

Opportunity for fruitful observation by the dentist.

Regular examination and prophylaxis is the safest measure to accomplish these results. Consequently, we should commence this service for the children in our practice if we are to bring a high percentage of them to adult life with a full complement of teeth having vital pulps and a healthy periodontium.

314 Somerset Bldg.

2. Hayden, Gillette: Clinical Results from Periodic Prophylactic Treatments, J.A.D.A., 13: 652 (May) 1926.

# THE PRINCIPLES OF PRACTICE IN PERIODONTIA—ROOT SURGERY*

By JULIAN SMITH, D.D.S., Dallas, Texas

"CLEANLINESS is next to Godliness" is an old proverb, and nowhere does it apply more perfectly than in the treatment of disease. The human body, as Nature intended it, is a perfect piece of machinery, readily absorbing and distributing such life-giving elements as it demands and equally efficient in eliminating all refuse matter, after the vital elements have been extracted. Just as long as we can keep this human machinery free from evil influences, a clean, coordinating, automatic entity, just so long will we have a perfect state of health; but the instant that we permit the invasion of an element that interferes with the perfect functioning of any part of the organism, that instant we inaugurate a disturbance that may result in breaking down the entire structure and so bring about a perverted condition, which we recognize under the generic title—"disease." "The treatment of disease," as expressed by Stillman and McCall, "consists of measures designed to restore the organism, or any of its parts, to

*Read before the Section on Periodontia at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

health. The aim of treatment is to remove those factors which are responsible for the occurrence of disease, and to give momentum to the biologic forces of repair."

The existing conditions in periodontoclasia are evidently brought about directly by local influences, aided indirectly by systemic conditions, as contributary causes, resulting in a lowered tissue resistance and the ready destruction of the integral parts of the periodontium.

We shall consider principles of practice as based on three separate etiologic factors, each distinctive in its influence, and yet coalescing in the general destructive process known to us as periodontoclasia. These factors we shall consider under the heading of physiologic, pathologic and mechanical principles.

A perverted organism cannot function properly; consequently, we must accept the principle that normal function is the keystone of health, and its establishment is a requisite in prevention of disease, and the maintenance of health after treatment. In order to establish normal function, it is necessary to study the mouth as a whole, then make a differential diagnosis, in order to determine a selective method of treatment for the correction of individual disturbing factors.

The pathology of periodontoclasia is not fully developed as yet by research, although many of our foremost students, in this line, have agreed on important pathologic findings. As seen at present, the best demonstrated factors seem to be: disturbance of function, i.e., traumatic occlusion; presence of holding medium for bacteria; infection by bacteria so held, and irritation by calcific deposits, roughened root surfaces, etc. These seem to be the dominating influence in the maintenance of the disease.

Dr. Box, in his "Studies in Periodontal Pathology," gives us a most vivid description of the development of the destructive process in the formation of deep pockets which is as definite as the progressive steps in the formation of alveolar abscess, from the inceptive decay in the dentin to the development of the periapical sac. Under the title "Chronic Periodontitis, Complex," he describes the two principle pathologic influences; viz., rarefying pericementitis fibrosa and infective periodontitis, the former being a process by which the pericementum is replaced by a new pulplike tissue, which interferes with its normal function, causing a rarefying process to take place in the adjacent bone, and a lowered resistance in the rarefied area. This condition is possibly the first influence developed in the process of destruction in the alveolar bone. Without this preparatory condition, the infective periodontitis would result itself into a "chronic periodontitis, simplex," a condition whose dominating feature is a gingival lesion, not very extensive, and slow pocket-formation. When the rarefying process has destroyed, to some extent, the resistance in the bone, the infective periodontitis, in its progressive sequence of chronic gingivitis, to chronic pericementitis to infective osteitis, rapidly invades, infects and destroys the adjacent structure, thus completing the complex, and creating the so-called pyorrhea pocket.

That the originating feature of the disintegration of the periodontium is largely due to mechanical influences is proved by the fact that correction and

removal of mechanical irritants invariably brings about a resolution of repair. Adjustment of occlusion, restoration of contact points, reproduction of perfect tooth form and competent and intelligent root surgery are the important points in treatment.

The effect of occlusal trauma are so far-reaching that time forbids its study in detail. Not only is it the prime factor in producing rarefying pericementitis fibrosa, but it includes almost all pathologic disturbances in the periodontium, even extending its influence to the gingival border of the tooth, producing ulatrophia and sensitiveness of the tooth surface. Stillman reports a case, diagnosed as tic douloureux, that yielded to the correction of occlusion in one molar tooth. The ideal method of correction of occlusal trauma would be by orthodontic measures, but as that method of procedure is rarely practical, a reduction of points of excessive strain by grinding is our best method of producing coordination.

The term "perfect tooth form," as used above, is a comprehensive one, because, in order to produce a perfect tooth form, you must include a restoration of contact points, proper occlusive planes and reproduction of the marginal ridge; all of which are of utmost importance.

Root surgery is the *sine qua non* in the treatment of periodontoclasia, because in the root surface are centered all the continuing etiologic factors resultant from outside influences. The treatment of periodontoclasia differs in no way from the treatment of other disease conditions. The factors mainly responsible for the development of the disease must be determined, and treatment along those lines must be inaugurated.

"A general consideration of the etiology of the disease reveals mechanical factors—lowering of tissue resistance and bacterial invasion as the usual conspicuous landmarks. Treatment must be directed toward the relief of mechanical irritation, reduction of the bacterial count and stimulation of cell vitality." (Stillman and McCall.)

Before any mechanical relief is inaugurated, the mouth must be put in as sanitary condition as possible. The patient must be taught proper mouth toilet. The technic of tooth brushing and the application of mouth washes must be demonstrated, and the idea impressed that the stimulation of the tissue is the energizing influence that operates the biogenic forces.

Normal stimulation is produced by Nature, through the process of mastication, but, unfortunately, correct mastication is a lost art in our day and time, owing to the character of food that we use and the lack of time that we have in which to masticate it. And here the subject of diet arises, but time forbids our consideration of that important subject.

In the absence of proper foods, with consequent faulty mastication, the tissues do not receive their necessary stimulation and we must substitute artificial stimulation to raise resistance. This is done by the proper application of the toothbrush and mouth washes. The instruction to the patient of the technic of tooth brushing is not generally effective, unless accompanied by an intelligent explanation of the cause and effect of that operation. You must show and explain in their own mouths that each bit of pressure with the brush at the

gingival border forces the blood out of the venules into the veins, and the recurrent filling of the venules with a fresh supply of blood from the arteries is a cleansing and stimulating process. Tell them of the biologic principles involved in reducing congestion in the arterioles and venules, and the value of a fresh clean supply of blood in the tissues at all times; in fact, treat them as intelligent human beings, and whether they understand or not, they will feel complimented and will work in unison with you. This kind of instruction has a beneficial psychologic effect that is invaluable in stimulating their interest. Thorough cooperation of the patient is as important as root surgery. The value of mouth washes, used vigorously and copiously, must also be explained and advocated. The mechanical effect of vigorously forcing a liquid back and forth between the teeth is very stimulating besides removing irritating substances that find lodgment in these spaces.

Having instructed the patient in regard to proper mouth toilet, we next proceed with a general prophylactic treatment, removing all visible deposits, and any large nodules near the gingival border. Smooth and polish these surfaces as well as possible, also the tooth crown. A period of three or four days' rest is now advisable, with the patient under observation. Gingival inflammation and soreness will largely disappear in a week, although pus may still be in evidence in the deeper pockets.

The correction of traumatic occlusion may next be undertaken, and after a further short period of rest, the improved appearance of the tissues will indicate that the time for final apoxesis has arrived.

The root surface is the holding medium for bacteria, the point from which infection is distributed, and is also the seat of calcific deposits, salivary or serumnal, continuing a local mechanical and bacterial irritation in the adjacent tissues. The removal of all sources of irritation and infection, from the root surface, requires the utmost mechanical skill. The early part of the operation requires, necessarily, instruments of sufficient strength to remove heavy deposits, and, at the same time, light enough in form to produce the least possible disturbance in adjacent tissues. For this purpose, I use a modified form of No. 2 D. D. Smith scaler, but other types of scalers are equally effective. After removal of excrescences by such instruments, suitable files are used to smooth the surface, preparatory to the final polishing with sharp instruments. The process of planing and polishing the root surface is the essential part of root surgery. There are two distinct types of instruments used for this purpose, designated as planes and curets. The tyro in this work must determine which of these types he prefers and perfect himself in the technic of handling that type.

Up to this point, the cementum has not been disturbed, as sharp cutting instruments should not be used for the preliminary work. As we now approach the surface of the cementum, we realize that the infection has penetrated superficially into this structure, owing to penetration of the attaching fibers of the pericementum, and curettement of this surface to remove such infection is demanded. As the enamel surface on the tooth crown protects the dentin, the cementum has also a protective covering consisting of a dense, noncellular

cementum to protect the more cellular structure beneath; but, according to Dr. Box, this protective lining varies in thickness to such a degree that, in places, it is as thin as one-half the diameter of a human hair. Accepting the theory that the surface of the root must be curetted, in order to remove the superficial infection described above; accepting also Dr. Box's statement in regard to the thickness of the protective cementum, we readily realize the exquisite skill required to remove a sufficient area of the surface to eradicate the infection and, at the same time, to prevent penetration into the cellular structure beneath. I eradicate from my mind all idea of curettement, after the root surface is smoothed with files, and devote my efforts to polishing such surfaces with small, sharp curets. By the time we have polished the surface, we have removed a sufficiency of the dense cementum to eliminate the superficial infection, without chance of invasion of the cellular cementum. The polishing instruments should be extremely sharp, so that, with very light strokes, becoming lighter and lighter, the root surface can be brought to a perfect polish. It is most important that this be done with very sharp instruments, as dull instruments, while they might polish a smooth surface, would do so more on a burnishing principle, precluding any possibility of a reattachment, and not altogether removing the superficial infection. In the use of the term "polishing," I want to stress the fact that this process is accomplished with sharp curets, and no effort is made to introduce any other method. No powder or applicator is necessary, as you can put a polish on a root surface with sharp instruments that cannot be improved on with a lathe.

A haphazard method of instrumentation is never effective. Adopt the system that seems to you most efficacious in the hands of experts, and perfect yourself along those lines. Use as few instruments as possible, in order that your fingers may be educated along specialized lines. Make your operation a sequential one, accomplishing one step before beginning another, placing your entire operation on as definite a basis as the insertion of an inlay.

There are three approved methods of procedure in the treatment of periodontoclasia, each of which has its advocates: (1) what is known as the flap operation, in which the detached tissue is split and laid back, so that a visible field is presented, the flaps being reunited with sutures after curettement is accomplished; (2) the elimination of all pockets by the radical removal of all detached or hypertrophied soft tissue, and (3) curettement without removal of any tissue, relying on absorption after inflammation subsides, bone regeneration and reattachments, for ultimate results. Beautiful results are obtained by all methods in the hands of experts. Each has its advantages as well as its disadvantages. Medicines have no place in the treatment of periodontoclasia. Accepting the fact that the root surface is the holding medium for all causes and the source of irritation and infection, the surgical cleansing and polishing of these surfaces, rendering them immune, permits the natural biologic forces to become operative, to the end that we obtain bone regeneration and tissue reattachment, in a genuinely healthy surrounding. Building up immunity and increasing resistance is the

real remedy. Destroying infection with strong germicidal agents is merely a temporary measure.

Instruction in home treatment is a most important feature in this work; for all that we can do is to remove the cause; whereas, the real cure must be effected through cleanliness and stimulation brought about by the intelligent use of the toothbrush and mouth washes.

Just a word about mouth washes. I consider a mouth wash, properly used, of equal importance with the toothbrush. Medicinal mouth washes are valuable as sterilizers, also for their psychologic effect, but the real value of a mouth wash is in its method of application. If used vigorously and copiously, it is a wonderfully cleansing and stimulating medium.

Education of mind and fingers is a first requisite in periodontia, but 100 per cent conscience is also a prerequisite.

> First, to thine own self be true,
> And it must follow as the night the day,
> Thou canst not then be false to any man.

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# THE PRINCIPLES OF PRACTICE IN PERIODONTIA*

By ARTHUR H. MERRITT, D.D.S., F.A.C.D., New York City

BEST opens his paper on "Examination and Case Records" with the statement that the greatest present-day need in dentistry is in the field of diagnosis, and that a simplified, well-balanced and rational form of diagnosis is also a great need of the present day. He emphasizes the importance in diagnosis of full and complete examination and case records.

It is made clear at once that he is treating the subject from the standpoint of the general practitioner, at the same time expressing the belief that there has been too much rambling in the field of medical science, and too much responsibility placed on the specialist, where it does not belong.

The practice of dentistry, which, according to Best, may logically be divided into two equally and vitally interdependent branches, stomatology and restorative dentistry, depends for its success on (1) knowing the patient's general and local condition of health; (2) examining thoroughly the oral cavity in order to bring to light all local conditions; (3) placing the mouth in a healthy condition preliminary to any other treatment; (4) providing such restorative treatment as may be required; (5) following and supplementing all this with regular prophylaxis, plus instructions in personal care.

As a preliminary to correct diagnosis, and following out his suggestions regarding the importance of a thorough oral examination, he recommends (1) complete roentgen-ray examination; (2) a vitality test of all teeth; (3) study models; (4) a history of the general health; this to be followed by a

*As correlated from the symposium presented by Drs. Best, Hartzell, James, Garvin and Smith.

*Read before the Section on Peridontia at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

most minute and painstaking examination of the entire mouth and adjacent structures. The data so obtained are then carefully recorded on a chart provided for that purpose, and form the basis for subsequent treatment. Not less than one and one-half hours is spent on this examination.

It will be observed that these recommendations for the successful practice of dentistry, as laid down by Best, and prepared from the standpoint of the general practitioner, apply with equal force to periodontia. In no department of dentistry is diagnosis of more importance than in the periodontia, which, as its name implies, is concerned with that which is fundamental in dentistry—the health and well-being of the supporting tissues of the teeth.

It is quite proper that we should turn to a consideration of these tissues, and the diseases that affect them, their causes, and treatment.

Hartzell, in his presentation of the "Etiology and Control of Periodontoclasia," confines himself largely to a consideration of that type of disease commonly called pyorrhea, the etiology of which he says is very simple, consisting of all those factors which tend to break down the normal resistance of the tissues to bacterial invasion. Among these invaders, the streptococcus is the first and chief offender, followed by the staphylococcus. It is these two organisms that Hartzell regards as the principal agents in the cause of suppurative periodontoclasia, which, he says, cannot exist without the presence of pyogenic bacteria.

So positive is he of this that he expresses the belief that, if the teeth be kept scrupulously clean at their junction with the soft tissues and, in addition, the soft tissues be properly stimulated by friction and pressure, such adverse factors as faulty diet or traumatic occlusion will not cause the development of so-called pyorrhea.

James admits their importance, saying that, whenever gingival inflammation is present, streptococci will be found attacking the tissue cells, and that later, when the chronic stage has been reached, the staphylococci will be found as the pus-forming organisms. Garvin, on the other hand, seriously "questions the importance of the statement so often made that periodontoclasia can exist only as the result of the streptococcus and staphylococcus." He further expresses the belief that the spirochete plays a much greater rôle in this disease than is generally believed.

The destruction of the epithelium, lining the crevicular surface of the gingivae, and the destruction also of the fibers at the floor of the gingival crevice, are believed by Hartzell to be caused entirely by the action of bacteria, their ferments and toxins.

The characteristic tissue reaction to the invasion of the streptococcus is a metaplastic fibrosis, such as has been observed, under certain conditions, in the pericementum, heart muscle, kidney, etc. This is an observation of the utmost importance to the periodontist; for if these histopathologic changes occurring in the pericementum and believed by Box and others to be due to occlusal trauma are, in reality, due to bacterial invasion, as Noyes believes, and Hartzell asserts, it will revolutionize our mode of treatment. It should mean less tooth grinding by the heedless and a wider appreciation, by all, of the real significance of oral hygiene as it applies to the gingivae.

These changes in the pericementum are referred to by Julian Smith, who says that not only is traumatic occlusion the prime causative factor in "rarefying pericementitis fibrosa," but that it is responsible for most of the pathologic disturbances in the periodontium, even extending its influence to the gingival border, producing ulatrophia and sensitiveness of tooth surface. These observations cannot both be true. One is a complete contradiction of the other.

The observation is made that the submucous connective tissue of the gums and the epithelium also can be greatly increased in bulk, density and circulation, and their resistance to bacterial invasion increased thereby.

In concluding his paper, Hartzell expresses the belief that sodium ricinoleate represents a valuable adjunct in that it not only neutralizes bacterial ferments and toxins, but also destroys streptococci, without injury to tissue cells.

This leads, quite properly, to a consideration of the "sequence of steps in treatment," a subject which has, in the present symposium, been covered by Garvin, and is believed by him to be of prime importance, since failure will attend the most painstaking efforts in treatment if proper sequence is not observed. While this is true, it is also true that all cases cannot be treated alike. In one case, it may be that bad hygiene is the outstanding feature, while in another it may be occlusal trauma, low tissue tone, etc., or all these in varying combinations. Nevertheless, a certain sequence in treatment can and should be observed in all cases, to be modified in a given instance as need be. This general plan is outlined in detail by Garvin. He begins by asserting the importance of a most painstaking and complete examination; in this, indorsing and emphasizing all that Best has said, and like Best, lamenting the fact that this is so infrequently done, expressing the belief that this explains most of the failures in treatment.

As a preliminary to treatment, he recommends roentgen-ray examinations, study models, tests for pulp vitality, oral prophylaxis, etc., following this with a searching examination of the entire mouth, not forgetting the importance to the record so obtained of a more or less detailed history of the patient's general health. The latter he regards as of the utmost importance.

With all data available, the diagnosis is made and treatment outlined. When necessary, the cooperation of the physician is sought; pulpless teeth that have been condemned are extracted; the occlusion is studied and, if necessary, corrected; apoxesis is undertaken and, when completed, is followed by such restorative measures as may be found necessary. Again is urged, as a postoperative precaution, the importance of frequent and more or less regular prophylaxis, with the usual detailed instructions to the patient concerning personal care.

Up to this point, the importance of diagnosis, case records, etiology and sequence of steps in treatment have been considered. It now remains to consider that for which all these have prepared the way, treatment.

This, according to Julian Smith, who contributes the paper on "Root Surgery," consists in the correction of occlusion, restoration of contact points, reproduction of tooth form and intelligent root surgery, adding that the latter is the *sine qua non* in treatment, since

it is upon the root surface that all the continuing causes of the condition resulting from other influences are centered. Preliminary to treatment, he recommends that the mouth be placed in a sanitary condition, thus corroborating the suggestion made by Best and Garvin. This is followed by occusal adjustment, and, after an interval of a few days, apoxesis is begun. The process of planing and polishing the root surface is the essential thing in root surgery. The first step in this operation is the removal of calculary deposits, after which files are used for smoothing the surfaces, preparatory to final polishing with sharp and more delicate instruments, the next and final step in root surgery, made necessary by the superficial penetration of infection into the structures of the cementum, along the line of the attaching fibers of the pericementum. This is accomplished through the use of small sharp curets, their purpose being to polish, rather than cut into, the cementum. No other polishing agents are employed. By this surgical cleansing and polishing of the root surfaces, Nature is encouraged to reassert herself, to the end that bone regeneration and tissue reattachment may occur.

Allusion is made to three types of operation: gum excision, gum resection and curettement without tissue removal, all of which, it is stated, bear good results in the hands of experts. No statement is made regarding their relative merits, nor whether it is good practice to follow either of the more radical methods as a routine practice. If this is meant, it is doubtful whether such statement correctly represents present-day periodontia.

Garvin expresses the belief that surgical interference is of great assistance in clearing up stubborn cases, but recommends that such treatment be deferred until other treatment, designed to contract the gingivae, has been given, after which there should be removed only such tissue as may be necessary to obtain free drainage. He does not approve of it as a routine measure.

To prophylaxis and personal care is given the same importance that is accorded them by Best. Emphasis is placed on the use of mouth washes, chiefly for their cleansing and stimulating effect.

"The aims and results of treatment" are outlined by James, who, in his opening paragraph, makes it clear that the one aim of periodontia is to prevent the development of disease within its field of operation, and that, in its efforts to do this, it has established, beyond question, the necessity for early recognition and removal of all forms of gingival irritation. When this is done in a thorough-going manner, it will not only prevent infection of the gingivae and supporting tissues, but will also prevent, in large measure, the development of dental caries and their sequelae. Through the recognition and correction of diet deficiency, the periodontist, who has unusual opportunities for the observation of such deficiencies, must also strive to build up resistance to disease. Further, it is his especial duty to build up local resistance through the teaching of the principles of mouth hygiene and the proper use of the toothbrush, in order that, through these, provision may be made for the lack of functional exercise imposed on the teeth and jaws through modern conditions of civilization.

To the periodontist, the problem of ridding the mouth of infection is simply that of eliminating those conditions in the mouth which make for bacterial accumulation and growth. To this end, it is necessary that he assume full responsibility in each case for removing from the mouth all forms of irritation, mechanical, bacterial and chemical; for placing all tooth surfaces in such condition that they may be kept clean, and for carefully instructing and training the patient in the ways necessary to maintain this condition.

This is the *aim* of all treatment in periodontia; and when these principles are observed, it is James' belief (and this is concurred in by every other contributor to the symposium) that more definite results are accomplished than by any other means in dentistry.

It will be observed that there are but two points about which there is a division of opinion as regards principles of practice in periodontia; that regarding the etiologic rôle of the streptococcus, and that regarding the causative factor in so-called "rarefying pericementitis fibrosa." The weight of evidence, as brought out in the symposium and in the writings of other investigators, strongly supports the contention that the streptococcus is an exceedingly important etiologic factor in periodontal diseases, and should be given serious consideration. The evidence that pericemental fibrosis is caused by streptococcal invasion is even more conclusive, supplemented as it is also by the studies of many investigators.

The following brief summary outlines the points about which the essayists generally agree.

1. Diagnosis, to be made only after a much more searching and comprehensive examination than is usually made.
2. Case records, on which are recorded in detail the results of the examination that is to form the basis in treatment.
3. Roentgen-ray examination, with study models, vitality tests and oral prophylaxis, as a part of the examination preliminary to treatment.
4. Sequence in treatment, it being believed that failure to recognize the importance of this explains many failures.
5. Occlusion, the importance of this in treatment being generally recognized.
6. Root surgery, regarded as the *sine qua non* in treatment.
7. Prophylaxis, an essential part of postoperative care.
8. Personal care by the patient.

58 West Forty-Seventh Street.

# The Journal of the American Dental Association

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## *Editorial*

### A SERIOUS MENACE

In all the controversy that has raged about labor unions, the professions have for the most part remained silent and neutral. They have assumed that as long as they were not interfered with in their service to the people, it was not their function to take sides in any conflict between capital and labor. It was supposed to be a question which concerned only the large industries—in other words, it was a commercial rather than a professional problem.

But recently a situation has arisen which constitutes itself a real menace to dentistry, and the sooner it is faced and grappled with, the better it will be, not only for the profession, but in particular for the people we serve. A determined effort is now being made to introduce trade unionism to the dental laboratories of Chicago. A charter has been obtained of the American Federation of Labor, and at this writing, a strike is in operation in an attempt to force recognition of the union.

It is conservatively estimated that 90 per cent of the dentists

of our large cities depend on laboratories to help them in their prosthetic work, and it is well known that in the smaller towns it is becoming more and more the practice to send such work to the professional laboratories.

There is no longer force to the argument, sometimes made, that this work should be done in the dental office under the eyes of the practitioner himself. Sound as the argument may be from a logical basis, it is wholly untenable for the simple reason that the profession will never conform to it. We are facing a condition and not a theory. So it has come about that the dentist in his service to the public relies on the laboratory to do that mechanical part of the work which to him has grown irksome, and which consumes more of his time than he can afford to give to it.

On the general principle of trade unionism, we have nothing to say. Doubtless in some of the larger industries where capital had been domineering and unreasonable, there was the grim necessity for labor to organize in its own protection. All fair-minded people will gladly grant to labor this privilege, and will applaud every honest effort for the establishment of equity and justice between man and man. But what has been the history of unionism wherever it has gained sufficient power to usurp authority and exercise its will? It has been one series of lawlessness, intimidation and arrogance of the worst stripe. It has not stopped at the foulest crimes on the calendar to carry out its ends. It has beaten husbands, intimidated innocent wives and ruthlessly shot down those who expressed an honest difference of opinion. It has ridden rough shod over every human right, and has pursued a policy of obstruction and oppression which would bring the blush of shame to the cheeks of the perpetrators of the most fiendish practices of the dark ages. And the pity of it is that many of the plain, honest and faithful laboring men who have been forced into the unions have had to bear the onus of these vile methods of their leaders till the very name of a union man, good or bad, has almost become anathema in the land.

No man has the moral right, and he should never be given the legal right, to interfere with any other man in his laudable

attempt to earn an honest living or to provide for his wife and children.

This and much more might be recorded of the operation of unionism in the large industries of our country, but what shall be said when this baneful influence is being projected into our professional activities? It has been confidently stated—and on the record made by unionism in other enterprises it may be readily believed—that if the unions are successful in their attempt to organize the dental mechanics, they will soon walk into the office of a dentist and forbid him from doing his own prosthetic work, and compel him to patronize a laboratory which is operated under their control.

Whatever may be the status of the industries, this much must be said for the professions: they shall never be coerced into following the dictates of a union which shall limit the possibilities of their highest and noblest service to the people. In the present instance, it is pertinent to remark that there is no legitimate grievance on the part of the mechanics who are out on strike. Their hours are not irksome, and their salaries are acknowledged to be satisfactory, some of them averaging as much as $110 a week; with not a dollar of investment or any overhead expense. They would be at their work now were it not for intimidation by the labor leaders. The whole point at issue is the question of unionizing the laboratories and bringing them under the domination of a few men who know nothing of the obligations involved in professional life, and who care less.

What would the public think of a physician or a dentist who would lay down a rule as to the precise moment when he would begin to relieve a suffering patient, or who would cease his efforts when the clock struck a certain hour, whether or not the suffering was controlled? It has been the chief glory of the professions that their members have placed themselves at the service of those who were in trouble, at any hour of the day or night; and when the time shall come that directly or indirectly any interference with the divine privilege of service is attempted with the dental profession, that moment there shall go out from

the hearts of the profession such a spirit of righteous resentment that no force on earth can withstand it. We are going to live up to the best traditions of our calling, and we never can do that by bowing our heads to the dictates of any man or set of men who have exhibited the attitude toward humanity displayed by the labor unions of the past. This strike must not succeed, and no similar strike will ever be permitted to succeed as long as the spirit of true professionalism is dominant in our ranks, and as long as we continue to subscribe to the fundamental doctrine of equity, justice and fair play.

## A LESSON FOR DENTISTRY

At a meeting of the Federation of State Medical Boards, and of the Council on Education, Licensure and Hospitals of the American Medical Association, there were some sentiments expressed by the leading men in medicine which might well apply in a measure to dentistry.

Dr. William J. Mayo of Rochester, Minn., is quoted as saying: "Today one can truthfully say that medical researches designed to relieve generations yet unborn are looked upon as being almost holy, whereas the relief of people who are now miserable and suffering is, too often, looked on as rather sordid and commercial. Today we are suffering from too much knowledge too widely diffused. We devote too much effort to driving home detailed information and too little to the development of perspective."

And that is one trouble with dentistry—we do not see broadly enough to gain a proper perspective. Like medicine, we seize some passing fad and hug it to our bosom as if it were sacred, and as if the divine light had broken in on us for the first time. We suddenly forget the outstanding facts of dentistry—facts demonstrated by decades of hard experience—and we go off at a tangent just as medicine does. Dr. Mayo hardly means what he says when he remarks that "We are suffering from too much knowledge too widely diffused." What he really meant was prob-

ably that there was too much which we thought was knowledge. We have suffered in both medicine and dentistry from the assumption of knowledge which was not knowledge at all. He also says: "The present cost of medical education, the number of years before men can be self-supporting, and the age at which students graduate, averaging around 27, are driving many bright young men into other professions."

Here is a warning for our dental educators. We need advancement in our educational methods, but we must not advance our standards so rapidily that we shall keep out these bright young men and limit the output of graduates to the point where the common people are not being adequately served. In our professional schools, there must be sufficient utilitarianism to take into account the needs of all classes and not merely the scions of wealth.

Dr. Ray Lyman Wilbur, president of Stanford University, gave utterance to the following:

> For the most part, the medical curriculum is static, rigid and shot full of antique methods, ideas and procedures. It often misguides individuals into the belief that they have completed their education when they have wandered successfully through its intricacies and mazes. It is difficult to train a man or woman to work largely with his hands and senses in the care of the sick when he has been brought up in the present pass-the-buck atmosphere of the ordinary hospital mechanism for the diagnosis and care of the sick. The more work done by the student and the less by the teacher, the better the product. It is not what we know but what we actually use that counts in medical practice. Don't measure education in the terms of talk. Get that.

We are tempted to remark that, in professional education, it is not wise to measure anything in terms of talk. We have always felt that our examinations of students for a diploma or a state board license were conducted in an archaic and foolish manner. The mere ability to use words in the description of any procedure is not evidence of sufficient skill to minister to a patient, nor does it demonstrate the possession of judgment adequate to meet many of the emergencies in practice. We are constantly overlooking some of the real essentials in our examination of students. How far do we inquire into the moral fiber of a can-

didate? How much do we actually know about the tendencies of a young man in his attitude toward the patient whom he is to serve—whether he will be inclined to treat the patient honorably or to impose on him? Technical skill and scientific knowledge are of course necessary for the professional man, but so also is integrity of character. And we seldom look into that. When the contention is made that we should do this, it is met with the argument that it cannot be done. It can—at least to a greater degree than we are doing it today. The moral obligation of the professional man is one of the most sacred things connected with such a calling, and we are not doing justice to our students when we fail to emphasize that fact.

In line with our editorial in the April issue, Dr. Arthur Dean Bevan said at this same meeting: "The medical man who deceives his patient by some scheme of division of fees might just as well pick his patient's pockets."

It is wholesome to have distinguished members of the medical profession come out so frankly against the abuses in their profession. It is only by exposure that abuses can be remedied, and it would be well for the dental profession to pay heed to what these splendid men have said, and profit by it.

In dental education, there is a grave danger that we may drift away from some of the ideas which have resulted in its greatest good. When Dr. Wilbur said: "The more work done by the student and the less by the teacher, the better the product," he uttered a profound truth; and one of the strongest recommendations of our better dental schools is that this very thing is being done. The students are compelled to do the work, of course under the supervision of the instructor, and any system which minimizes this idea and substitutes for it mere academic teaching will seriously detract from the value of the service rendered the student. The difference between knowing how a thing should be done, and the ability to actually do the thing is so vast that it constitutes the difference between failure and success in practice, and one of the strongest recommendations of our dental educational methods has been the fact that so much emphasis has been

placed on the necessity for practical work on the part of the student.

It may as well be repeated here that, in order to be a good dentist, a man must have a rare order of ability. He must not only know things with his brain, but he must be able to do things with his hands, and any plan which tends to minimize either of these qualifications detracts from the efficiency of the finished product. In all conscience, we send our young men out to practice with meager enough ability to meet the emergencies of professional life, but if we take from them the prop of practical instructions, we have robbed them of one of the most essential qualifications for taking proper care of the people. And in the ultimate analysis, the ability to care properly for the people should form the chief *motif* of all our educational activities.

## WATCH YOUR THINKING

If every individual would recognize the power of thought in its influence on character, he would be more careful of his thinking. That there is a definite and direct effect produced on the individual by every thought that passes through his brain, there can be no question. The reason we do not achieve our full measure of greatness is because we are hampered by the smallness of our thoughts. Every bad or unworthy thought puts a blight on our development, and the longer we harbor such a thought, the more we are handicapped in our normal growth.

We cannot always prevent a bad thought from entering our mind, but we can resolutely put it aside the moment we recognize it. And this is our supreme duty. If we thought better of our fellowmen; if we compelled our minds to dwell on all their good qualities and overlooked their bad qualities, we would thereby grow in grace ourselves and we would cultivate grace in others. Right thinking is a tonic not only to the mind but also to the body. Other things being equal, the man who thinks wholesome and generous and charitable thoughts is healthier and happier than the man who does not.

CHARLES ALBERT BRACKETT, D.M.D., F.A.C.D.
(1850-1927)

## CHARLES A. BRACKETT, D.M.D., F.A.C.D.

After an illness of two years, during the last five months of which he was bedridden, Dr. Charles Albert Brackett, of Newport, R. I., professor emeritus of oral pathology at Harvard University Dental School, died, March 20, 1927.

Dr. Brackett was born, Jan. 2, 1850, in Lempster, N. H. He began the study of dentistry under Dr. L. C. Taylor, of Holyoke, Mass., and, in 1871, entered the dental department of Harvard University. He graduated in 1873, and in July of that year came to Newport, where he continued in the practice of dentistry until his retirement about four years ago. Within one year after his graduation, he took a position as instructor in the Harvard University Dental School, and seven years later, he was appointed assistant professor of dental therapeutics. He became professor of dental therapeutics and pathology in 1890, a position which he held until 1919, when he was made professor of oral pathology. He acted as consulting dental surgeon at the Newport Hospital, and in addition cared for a large private practice. At the completion of his fifty years of service, he was made professor emeritus.

Public and semi-public affairs claimed his interest, and he was a generous contributor to many philanthropic enterprises. For more than twenty-five years he was a director in various banking institutions, and of one he was the vice-president. He was a trustee of the Newport Hospital, the People's Library and the Channing Memorial Church. He was the prime mover in the establishment of the representative council form of city government in Newport. It was through his efforts that a state board of registration in dentistry was authorized by law.

Dr. Brackett was a delegate to the International Medical Congress held in London in 1881, to the Ninth International Medical Congress in Washington in 1887 and to the World's Columbian Dental Congress in Chicago in 1893. He was a former president of the American Academy of Dental Science, and was looked upon as dean of the profession in New England.

Dr. Brackett was married, Feb. 3, 1886, to Miss Mary Irish Spencer, who survives him.

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## EDMUND NOYES, D.D.S., F.A.C.D.

By ARTHUR D. BLACK, Chicago, Illinois

Edmund Noyes was born in Abington, Mass., Jan. 16, 1842. On his mother's side, he was descended from Mary Chilton Winslow and also from John Alden and Priscilla Mullens, of Plymouth Rock fame; on the father's side, he had Norman English ancestors, who came to England with William the Conqueror.

When he was 13, his father moved the family to the then new settlement of Independence, Iowa. Along with many other frontier life experiences, young Noyes became the master of a school established on the Wapsipinicon river. He

studied dentistry with Dr. E. C. Clarke, of Dubuque, Iowa, later graduating from the Ohio College of Dental Surgery in Cincinnati. He began practice in Chicago in October, 1867. For many years, his office was in the old Dyche Drug Store building at the northwest corner of State and Randolph streets. He had been in continuous practice since that time—a period of nearly sixty years.

He joined the Chicago Dental Society in 1868, and the Illinois State Dental Society in 1872, and he was one of the ten founders of the Odontographic Society of Chicago. He was secretary of the Chicago Dental Society from 1876 to 1878, when he was elected president, and secretary of the Illinois State Dental Society, 1879 to 1883, for which he served as president in 1884. The editorship of the society's transactions was held by him from 1904 until the time of his death, March 28, 1927.

He wrote the standard textbook on dental ethics and jurisprudence, which has been in use for many years by the leading dental colleges, and also a history of operative dentistry, published as a part of Koch's "History of Dentistry." He contributed many articles to dental periodical literature.

Dr. Noyes was one of the group who organized the Dental Department of Northwestern University, in 1890, and has been a member of the faculty during the thirty-seven years of the school's existence.

No member of the dental profession has been more highly esteemed than Dr. Noyes. The Illinois State Dental Society gave a banquet in his honor in 1922, as did the Chicago Dental Society a few years before. His fidelity to the highest ideals in professional life wielded a powerful influence for better ethics among dentists the world over.

The alumni of Northwestern University Dental School presented the University with a bronze bust of Dr. Noyes by sculptor Frederick Hibbard in 1922.

Dr. Noyes died while visiting at the home of Dr. J. P. Buckley, Hollywood, California. He is survived by his widow, two daughters and four sons, among the latter, Dr. Frederick B. Noyes, Chicago, dean of the College of Dentistry of the University of Illinois and William A. Noyes, head of the department of chemistry of the University of Illinois.

# DEPARTMENT OF DENTAL HEALTH EDUCATION

## PRENATAL AND PRESCHOOL DENTAL SERVICE IN IOWA UNDER THE SHEPPARD-TOWNER ACT*

By GEORGE H. WANDEL, D.D.S., Iowa City, Iowa

A FEDERAL law officially known as "An Act for the promotion of the welfare and hygiene of maternity and infancy" was approved Nov. 23, 1921, to continue effective for five years from the end of the fiscal year, June 30, 1922. It made federal funds available when matched in part by state appropriations, the aggregate to be used in carrying on an educational program the sum of which was to reduce the rate of infant and maternal mortality. The Children's Bureau of the Department of Labor is the federal agency which administers this Act. The General Assembly of Iowa accepted the conditions contained in the federal law and appropriated funds to meet the full federal requirements and, on the signature of the governor of the state, it became a law in Iowa, April 4, 1923. The Iowa State Board of Education has charge of the administration of the Law in Iowa. The machinery created to do the work is the Division of Maternity and Infant Hygiene, with headquarters in the Extension Division of the University of Iowa at Iowa City. It, in turn, is governed by an advisory council made up of members of the faculty of the University, and the director of the Extension Division is also director of the Division of Maternity and Infant Hygiene.

The basic principle underlying the program of the Division of Maternity and Infant Hygiene under the Sheppard-Towner Law is one of education: to educate the general public to an appreciation of the importance of the public health problem; to make the individual realize that he owes it to society to be healthy.

To carry on this educational program two traveling dental clinics and one traveling dental clinic were formed. The medical clinic was composed of a pediatrician, a woman physician and a nurse. A medical clinic made a thorough physical examination of children, gave advise as to their care, and also advised expectant mothers as to their prenatal and postnatal needs. Suitable literature was distributed.

The dental clinic personnel includes a dentist (myself), a dental hygienist and a nurse. The nurse is the advance agent for the dental clinic.

*Read before the Section on Mouth Hygiene, Preventive Dentistry and Public Health at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

In order that you may visualize the duties of each of the members of the dental staff, the whole work of the clinic will be outlined.

Only those communities that send to clinic headquarters an invitation for the clinic to come to their community are visited. The invitation is usually a letter asking for information and requesting that a certain time be allotted to that locality for the visit of the clinic. This request usually comes from local dentists, a superintendent of schools of town or county, the head of the farm bureau, parent-teacher associations, women's clubs and the like. As a rule, the local dentists keep in the background in the organization of the clinic for fear that the public may think that there is a mercenary motive back of their activity. However, this has not lessened the interest and assistance evidenced by the local dentists.

On receipt of an invitation to visit a community the work of the advance nurse begins. She responds immediately, giving a brief explanation of the work, and arranges for an early interview. She usually requests that all influential and interested persons be present at this meeting, at which she goes into detail about the work. Sometimes, it is necessary for the nurse actually to sell the clinic to this group at this meeting, because, as is often the case, one person may have taken it upon herself to secure the services of the clinic. Unless the others present at the meeting know and understand the work of the clinic and their enthusiasm about the possible benefits to be obtained is developed they are liable to vote it down. After going to the expense and trouble of coming to this community to arrange for a clinic, it surely would not be good business to let the proposition fall through. Consequently, the nurse must thoroughly understand her work; must be able to overcome all obstacles; must be able to work up enthusiasm among her listeners, without which the clinic would be a dismal failure. This statement is made, not to leave the impression that we are forcing this program on the public but to show that if an educational plan is to be a success, we must educate. People want to know what they are receiving and how much work, money and time they are going to be called on to contribute. Once they understand, plans move along smoothly to completion.

It would be well here to outline the requirements the people in any community are supposed to meet in securing the services of our dental clinic. The local committee or group which is assuming responsibility for all arrangements must first secure the consent and cooperation of the local dentists for the visit of the clinic. While this is really a formality, we do not agree to enter any locality with the clinic without first being sure of the cooperation from local dentists. This is no more than professional etiquette. Furthermore, without the cooperation of local practitioners, followup work based upon the findings and recommendations of the clinic might prove a failure.

Next in order of requirement will be the necessary rooms in which to hold the clinic. It is usually arranged that there be one room for a reception room and one room for the clinic proper, with good light. This will prevent confusion and provides privacy for the mother in consultation with the dentist. Clinics are usually held in school buildings. They have been held in courthouses, town halls and lodge rooms. Wherever

the rooms, they are invariably used without charge being made for their use.

Another agreement is that the local committee must supply light, heat, water, soap and towels. This also does not often require an actual cash outlay by the committee as the first four items are usually donated with the rooms and local dentists frequently supply all necessary towels.

Last of all and very important to the success of the clinic is the volunteer help received in the way of chairman, subchairman, and clinic assistants. Of these, the chairman is the most important. It is this person who can make the clinic a success or a failure. The chairman is invariably a woman. She is selected upon the basis of her executive ability and popularity in the community. The advance nurse gives the chairman thorough instruction in working up the clinic. The chairman selects her own subchairman to assist her. Usually, a subchairman represents a certain portion of a town or rural community and each subchairman will be responsibile for the children examined from her particular district or ward.

All clinic work is done by appointment, to make it possible to adhere to a previously prepared schedule. Appointments are made on the basis of ten to fifteen minutes allotted to each patient. Twenty-five children are examined each day. In larger communities, each subchairman is allotted a day for her district. She must obtain enough appointments to fill that day. When we say that she must secure the appointments, that is exactly what she does. Regardless of all publicity, parents do not make appointments of their own free will and accord. They must be approached individually by the chairman or subchairman and educated to the value of the clinic, just as the advance nurse had to approach and educate the original group that met to consider the proposition in the first place. Newspaper items, attractive posters in store windows and announcements in school rooms and churches are necessary, and they pave the way and make it possible for the chairman and her assistants to approach and persuade the parent. Only now can you begin to realize the importance of securing the right type of advance nurse, chairman and assistants. Their selection constitutes success or failure. They must work hard and must be "on the job" all of the time, as it requires two to three weeks to cover thoroughly all arrangements necessary to the production of a successful and smooth running clinic.

The other volunteer assistants are usually four in number. One acts as secretary to the dental examiner and records all his findings and instructions on the examination blank. She is usually a person who is familiar with the names of the teeth and is a good penman. Two copyists make copies of the original examination blank, usually one for the parent and one for the chairman. The fourth assistant takes care of sterilization of instruments and assists the dental hygienist. The advance nurse usually has given these assistants all necessary instruction.

Publicity items appearing in newspapers are outlined by the advance nurse, to prevent misrepresentation, which can so easily occur, and, unintentional though it may be, can produce much trouble. It is always advisable to have this material properly censored. The more attractive the publicity, the better

are results obtained. Poster making by school children, poster contests, clinic attendance contests, church and school announcements are all a necessary part of the publicity side of the work. Publicity expense is all cared for locally.

Clinics are usually held from Tuesday to Saturday inclusive of each week, Sunday and Monday being occupied with traveling nearly all of which is done by train as long jumps are frequently necessary in going from one part of the state to another. These long jumps are made because of the expediency of holding clinics in different sections to obviate any impression of favoring any particular district.

The length of time spent in a locality depends on the population. A town of 1,000 inhabitants usually is given from one to two days. The opinion of the local committee members governs this to a large extent, as they know about how much time can be employed.

The only expense incurred by the town or district having the clinic is for towels, publicity and any local transportation of clinic equipment and staff members. We usually establish headquarters at the county seat and work from it into outlying districts, transportation being provided and paid for locally. This seldom requires an actual financial outlay, as, frequently, the county nurse carries the clinic staff and equipment in her car. Salaries of staff members, hotel bills and traveling expenses from clinic headquarters to local headquarters are all cared for by the Sheppard-Towner Fund. When the clinic staff and equipment have arrived in a community prepared to work, the latter is conveyed to the rooms where the clinic is to be held, unpacked and set up, and everything put in readiness for the first patient. The equipment consists of an S. S. White portable army dental chair, a Dunmore dental engine, electric sterilizer, prophylactic instruments, mirrors and explorers, the last not of the blunt variety but the small fine type.

Next, we get in touch with the chairman and assistants and check over all necessary instructions. By 9 a. m., we are ready for our first patient.

It is always understood that this is a preschool age dental clinic and this rule is quite rigidly adhered to. However, there is always an exception to every rule and there is one in this case. Many communities do not have a sufficient number of preschool children available to fill up their allotted time. Sometimes, we have broken appointments, and as all this time must be filled, we permit the admission of children of school age to fill up the time, usually pupils from one of the first three grades. Thus, we have really two groups of children visiting our clinic, preschool and school age. Each child must be accompanied by a parent or guardian. We do not deviate from this rule. We depend on our contact with the parent to make our work a success. The sooner the parent appreciates the value of a clean mouth for the child, the sooner will that child receive proper dental attention. Another angle of our selection of patients is also important. We caution the chairman and subchairman not to permit the clinic to take on the aspect of a charitable institution as that atmosphere drives away the very class of people we desire in the clinic, those that are able to afford dental attention after they have been convinced that they need it, can carry out the suggestions given in the clinic, and will more readily grasp the object

and meaning of the clinic. If all the patients were of the group that are unable to provide medical and dental attention for their children, the value of the clinic would be greatly lessened because advise for dental attention could not be carried out even though the parent might so desire. Few communities have made provision for complete medical and dental care for their poor. However, it is common knowledge that the son of the rich man or man of moderate means is just as susceptible to decay and just as neglected dentally as the poor man's son. Why not stress our efforts, then, on the class which, once convinced, is able to carry out the aims of its convictions? This produces the best results. Do not think that the poor are barred from the clinic: if they show any desire at all to take advantage of the privileges of the clinic, they are always welcomed and encouraged. Through such contacts, it has been made possible for many to secure dental attention for their children through some charitable organization or kindly dentist. Appreciated charity, especially when it comes as a result of an earnest desire to give a child a chance for good health, is usually to be had.

### ROUTINE OF EXAMINATION

A woman brings her daughter for examination. The chairman meets them at the door to what serves as the reception room, conducts them to a desk and makes entries on an examination blank of the child's name and age, the parent's name, the address and the date. The chairman now conducts them to the clinic room, where they are introduced to the dental examiner, who makes an examination of the child's mouth. This examination is as thorough as possible. All abnormalities are recorded and explained to the mother and she is cautioned to obtain early attention for these irregularities Prenatal and postnatal histories are secured and proper diet is greatly emphasized. Complete instruction is given in proper home care of the child's mouth. These instructions are all given verbally and are also briefly recorded on the examination blank by the assisting secretary, as previously explained. The original examination blank is retained for the examiner's records.

We will suppose that, among other conditions observed and recorded, the teeth were found to be in need of prophylactic attention. The child is now taken to the dental hygienist, who completes the visit to the clinic by cleaning the teeth. The hygienist often has to use all the ingenuity and power of persuasion she possesses in order to prevail on a child to have its teeth cleaned. Most of the children seen in the clinic have never been in a dental office or had anything done to the teeth. They come to the clinic with fear and trembling, usually, because of having overheard the conversation of some unthinking person who has gone through a painful operation in the dental chair. Or, they may have been threatened, the dentist being represented as a sort of "boogey man." Naturally, then, the child is afraid to have anything done in the mouth. Under the influence of the hygienist, a large proportion of these children get an entirely new idea of dental work. They climb down from the chair with smiles and say, "It didn't hurt at all," even though they may have complained on first getting into the chair. This change of attitude benefits the child, the parent and also the family dentist. It benefits the parents and child in that it

demonstrates to them, to quote C. J. Hollister, "an immediate realization of a benefit received." It benefits the family dentist in that it makes a good little patient for him of what might have been a bad and irritable patient. Such reports have been received from parents and dentists many times. This work of the hygienist is the nearest approach to actual operative work in the clinic. When sifted down to its finest point, it is really educational.

The visit to the clinic is now completed, and as the child and her mother leave the clinic room, they are given a copy of the examination blank and several pamphlets relating to child care and care of the teeth.

This is the usual routine with each little patient throughout days of clinics. It does not constitute all of the activity of the members of the staff. A brief report of last years activities follows.

### LAST YEAR'S ACTIVITIES

The hygienist gave prophylactic treatment to 1,401 children. She gave a total of ninety-four dental health talks, to 4,605 school children. She also gave a total of seventy toothbrush drills, to 3,468 school children. She thus reached a total of 9,474 children with prophylaxis, dental health talks and toothbrush drills combined.

I examined 484 school children and 1,694 preschool children and held ten to fifteen minute consultations with the parents of these children in each case. I also gave a total of 145 talks to 17,690 people as follows: 66 talks to a total of 12,960 school children; 45 talks to a total of 1,682 mothers and fathers; 17 talks to a total of 815 men's club members; 14 talks to a total of 195 dentists; 3 talks to a total of fifty-five physicians and dentists together; 4 talks to a total of 342 nurses, and 9 talks to a total of 1,681 people in miscellaneous groups.

An additional talk was given over the radio. Most of the other talks, with the exception of the talks to school children, were illustrated, a Picturol lantern being used.

It might appear at first glance that the number of children examined was small. It must not be forgotten that time included for consultation along with speaking engagements does not make it possible to examine many children. It is felt that the educational features of the work combined in the consultations with parents and in talks to interested groups is more important than a mere examination of the mouth. One person, convinced of the importance of mouth health for the child is worth ten persons who have no conception of it.

In a backward glance over past years, we feel that the public is rapidly coming to recognize the importance of a healthy mouth for the child. We are afraid that this trend of the public mind is more rapid than many dentists realize. It is really lamentable that only feeble efforts are made by many practitioners in giving attention to the needs of children who are brought to them for dental attention. All dentists admit that this is the most important and the most neglected phase of dentistry. We feel that we have been instrumental in helping the dentists to a realization of the need for giving child dentistry more and closer attention. This has been the professed intention of many of the dentists with whom we have been in contact in this work. It is going to take much time and patience to bring about much improved conditions.

In regard to causative factors in the production of tooth decay, nutrition still holds first place in our observation. The disturbance of nutrition, as in rickets; various children diseases; syphilis, and diabetes, all play their parts. Disturbance of the internal secreting glands enters into many of these cases. Too extended periods of feeding at the breast, that is, months beyond the normal weaning time, produces poor teeth in every case that we have observed especially if the mother's diet is poor. Of course, lack of cleanliness of the teeth surely must play a part in the production of decay. In considering nutrition, we must not lose sight of the great importance attached to the prenatal diet of the mother. The use of artificial feeding for babies is a phase of child nutrition that seems to have much to do with the poor character of the teeth of many children. The use of the highly advertised baby food is to be discouraged. A modified cow's milk seems to produce better teeth. Of course, breast feeding is always to be encouraged, and a well balanced diet for the mother is a great aid in making this possible.

### CONCLUSION

This work has proved highly successful, but as occurs in many good activities whose progress depends on political backing, this educational program for mother and child health appears to be on its last year of life. Congress, at the last session failed to provide for a continuation of the Act beyond the originally provided term of years. It is still hoped that something may develop which will make it possible to continue, in a still more aggressive manner, the educational work just begun, making it possible for every child to have eventually a healthy mouth, which makes for a useful, healthy and happy adult life.

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# COMMUNITY DENTAL CARE IN NORWAY*

By JOHN NILSEN,† Oslo, Norway

THE constituted authorities of Norway, both state and community, are displaying great interest in dental clinics as a civic enterprise. A law passed in December, 1917, provides: "The children must be assured the necessary dental treatment, and this must be accomplished in the space of ten years." This period is now extended by ten years, because of the present economic difficulties. The county communities occasionally receive from the state, in conformity with the cities, 25 per cent of their expenses in paying the salaries of dentists and in financing the dental service.

There are but a few cities without school clinics, but in both city and country, the work has been rendered difficult lately owing to economic conditions after the War.

Hitherto, school dental care was

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†Secretary of the Norwegian Association for Combating Dental Disease.

organized as a civic institution, just as is the dental care of adults, which, under sick fund compensation, is limited to extractions and a few minor operations at a fixed rate.

In connection with this, it may be mentioned that dental service has been established in the army and navy and that a great number of soldiers and sailors have their dental work done at these clinics.

As the result of the distribution of a circular to the greater hospitals of the country by the Norwegian Association for Combating Dental Disease, a permanent dental clinic has been established at the city hospital in Oslo, and we hope that others will be established. There is a dentist employed at Fredricsvern-Hospital-by-the-Shore for Scrofulous Children, and one at the public school for deaf and abnormal children, and dentists are also employed at the insane asylums.

This about covers the community dental care in Norway at the present time. The Norwegian Association for Combating Dental Disease has organized systematic propaganda for community dental care among the population, through the existing organization, particularly by educating the school children the school nurses and the nurses at the board of health. The association is cooperating with the Norwegian National Tuberculosis Association, the Sanitary Association of Norwegian Women and the Red Cross. Dentists are becoming increasingly interested in giving public lectures. During their military service, they are obliged to educate the soldiers through lectures. In this way, we not only spread information among the mass of the people, but we also promote a demand for the consideration, by the government, of dental disease as on the plane of other diseases. We believe that if only the great mass of the population, through educational work, get a clear understanding of the fundamental importance of good teeth in the general health, this need will be realized.

For this purpose, the association distributes pamphlets and has provided a series of films, available to every one, free of charge.

As formerly mentioned, we are of the opinion that systematic propaganda will lay the foundation for carrying out the dental care of the adult population. We must be prepared with a well-considered plan, attainable, in due time, at the smallest possible cost.

I presume that this congress has more interest in the actual problem than in a detailed report regarding the present state of school dentistry. This work is going forward after a well-founded plan, although, with us, as elsewhere, it is incomplete. The development of the community dental care of the future must, as I see it, include the following considerations.

1. This development must come about through community enterprise, not through that of private or semi-official associations, such as the establishment of public dental infirmaries by dental societies or other agencies. This latter will result only in weak institutions of short duration and slow growth, and, as temporary arrangements, they will only retard well-organized dental care.

2. The development must go on step by step; that is, when we work for our goal with school dental care as a basis, we increase the yearly service only by those cases in which systematic treatment has already been

given, or the teeth have been satisfactorily cared for by a private dentist.

Experience shows that to attempt to solve the entire problem at once will, in the first place, call for an amount of work which we could scarcely dare hope to finance by the authorities, because of the amount of apparatus and the number of operations required.

I here refer to clinical treatment. But suppose a municipal clinic has been established which is large enough to receive this large clientele: when the work is finished—if this could be imagined—the apparatus will prove too large for further community service. Even if we were to base this reform on the idea that all would thereafter frequent the dental office of his choice, we should meet with boundless difficulties, perhaps particularly in an economic way.

The reform must be subject to the municipal sick funds, which are, in Norway, based mostly upon a kind of cooperative insurance. The annual premium of the members forms the greater part of the funds. Who dare, under such circumstances, determine the annual premium? And would it not, at all events, have to be fixed so high that the members would object? Supposing the contributions to the fund were limited at a fixed maximum, the provision would be principally for emergency treatment, and we should never attain systematic and suitable service worthy of the community and our science.

If we, on the other hand, prefer to approach the ideal step by step, we shall surely gain our goal, and, at a minimum of expense, easily calculated and attainable, provided the work is organized in the right way. It is of vital importance that for the success of the entire movement this phase should be thoroughly canvassed before the proposal is presented to the authorities. Success or failure depends entirely on detailed annual systematic examination and treatment.

In the directions addressed to the societies of the respective countries by the Hygiene Commission, the principle of dental treatment by the dentist of choice is established. The question will then be: Will effective control under this arrangement be possible? After considering this matter thoroughly, I must answer in the negative. It appears to me that the only possible and worthy solution of the question regarding community dental care of adults lies in founding clinics supplied with permanently appointed and salaried dentists (along the lines of the school dental infirmaries connected with and managed by the municipal sick funds).

As a first step toward universal community dental care in Norway, I have proposed the following to the Norwegian Association for Combating Dental Disease. The proposal has not yet been discussed and is thus only my individual opinion as to what we should do first.

My proposal is that the municipal sick fund include in its contributions dental care for children before entering school and after leaving school, up to the age of 15 (the sick fund's limit for children); treatment to take place at the school infirmaries in idle hours (eventually in the afternoon hours) and to be given by the permanently appointed personnel, and, for this treatment, the sick funds to supply the community a fixed sum per child. The intention of this proposal is, in the first place, to insure treatment of the deciduous teeth and the first permanent molars

before it is too late, which, as a rule, is now the case. This is a step in the right direction, a shorter step made of that procedure by which the entire reform, by and by, ought to be realized.

I also have, on the basis of the working expenses of Oslo school dental clinics and the number of children in question, attempted to fix the annual sum per child, as the Oslo sick fund would have to take this into account. I am of the opinion that the calculation is too high, but I prefer to be on the safe side. From the pecuniary point of view, the community should, for its own part, consider what prophylactic treatment of minors will mean as regards the budget of the school dental clinics, and that the sick fund will surely be able to save this expense on the other accounts. It will, in other words, setting the hygienic considerations aside, pay both the communities and the sick fund to bring about the proposed reform, even if the compensation as regards the community, and the increase of the premium for the sick fund, will be lower than the estimate indicates.

It will, for many of the communities, offer a solution of the school dentistry problem, probably the only solution.

I ask that this be considered my contribution to the discussion of the most important problem within our profession today. If we attempt to establish a system that, in practice, will not answer our purpose and will reflect on our profession, our work will be at a standstill for many years.

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# ORAL HYGIENE MOVEMENT IN JAPAN*

By YOSHIO MUKAI, D.D.S., Tokyo, Japan

IT was in 1913 that the oral hygiene movement in Japan entered its active stage after a period of preparation extending over about twenty years. In February of that year, Tomijiro Kobayashi established the "Lion" itinerant dental corps, whose work was to disseminate oral hygiene among the masses. The Dental Federation of Japan, which had been making preparations for several years, held its first oral hygiene exhibition and meeting in July, 1915. Since that time, meetings have been held at various places, with great success. Tomijiro Kobayashi is the chief director of the itinerant corps and Sosaku Midorikawa is the lecturer. The late Dr. Sekiichi Enomoto was president of the Dental Federation of Japan. He was later succeeded by Morinosuke Chiwaki. Tsurukichi Okumura is in charge of the oral hygiene department, and I am the lecturer for the federation.

The activities of these two organizations have led the dental profession in Japan to direct more and more attention to matters of oral hygiene. The oral hygiene movement has shown remarkable progress in recent years.

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DISSEMINATION OF KNOWLEDGE REGARDING ORAL HYGIENE

What is by far the most important thing in spreading knowledge concerning oral hygiene is the education of the masses regarding the part oral hygiene plays in maintaining health. Lectures and exhibitions are the two important means for social education in the field of oral hygiene. Lectures are given to the following five groups: (1) children of kindergartens; (2) pupils of elementary, secondary and normal schools; (3) parents and guardians of students; (4) workers in factories; soldiers; employes of private and public institutions, and members of citizens' organizations; (5) educators and physicians.

In giving lectures to these five different groups, suitable topics are chosen for each group, and the lecturers are earnest and patient.

I believe that the following seven points should be observed in giving a lecture to children on oral hygiene. 1. Make the lecture as popular as possible without distorting its scientific content. 2. No lecture should be longer than forty minutes in duration. 3. Instruction given in the lecture should be adapted to the intellectual powers of the audience. 4. The natural inclinations of children should be regarded. 5. The spiritual and cultural phases should be emphasized. 6. Too many points should not be included in one lecture. 7. Special attention should be paid to the posture and pronunciation of the lecturer.

The number of the lectures given by the itinerant corps during the thirteen years between 1913 and 1925 to children in kindergartens, students of various schools, members of local young men's associations, soldiers and workers, is estimated at 6,725, and the number in the audiences is given as 5,303,565.

Extension lectures have been found most effective in disseminating knowledge concerning oral hygiene to teachers. In fact, it may be said that the extension lecture system is one of the few institutions which have made remarkable success in Japan. The first extension lecture was given in Tokyo in the summer of 1918 and continued for five days. Teachers of elementary, secondary and normal schools attended the lecture course. This first attempt has been followed by similar ones in the various parts of the country, mostly in summer. Twenty-nine such meetings were held in Japan during the eight years between 1918 and 1925 and the number in the audiences was estimated at about 1,246. The dentists' associations of the various parts of the country such as Chita County Association, Saitama Prefectural Association, Hiroshima, Fukuoka, Tottori, Hokkaido and others, held similar meetings for the teachers of the schools.

The Ministry of Education presents an annual medical lecture to which all school physicians are invited and in which dental subjects are included.

The number of the lectures given exclusively to young women during the same period is given as six, and the number in the audiences, 1,200.

Oral hygiene exhibitions are held chiefly to show popular charts, photographs and models. The making of models has been given close attention. The number of oral hygiene exhibitions held throughout Japan during the period between 1915 and 1925 is estimated at 131, and that of their spectators, 4,321,320. The number of hygiene exhibitions of the Lion Dental

Infirmary for Children held during the period 1921-1926 is estimated at 110, and their spectators are estimated at 3,507,850. Many exhibitions were held by other organizations.

### PRACTICAL EXERCISES IN ORAL HYGIENE

Practical exercises in oral hygiene given either individually or collectively are all-important, especially for children who are undergoing mental as well as physical development. It is best to create the habit of taking good care of the teeth. The following are the usual methods of keeping the teeth in a healthy condition: (1) the toothbrush drill; (2) the exercise of masticating the food; (3) mouth washing.

The Lion Dental Infirmary for Children made a nation-wide campaign to urge the children of the country to practice the toothbrush drill, and the number of the elementary schools which participated in the exercises in using the toothbrushes is estimated at 481. I believe that mastication exercises are the most effective method, and they have been found most successful when the experiment was carried on with the pupils of elementary and secondary schools. I first let children masticate a piece of food thirty times before swallowing it. Then the number is increased to forty and then to fifty. Apples, pickles and chewing gum are used as materials in these exercises. These exercises stimulate the development of facial muscles and the jaws in particular. During the period 1914-1926, I gave mastication exercises at 378 kindergartens and elementary and secondary schools.

### ORAL INSPECTION AND TREATMENT OF CHILDREN

Oral inspection of children and early treatment of their decayed teeth are all-important in meeting practical questions in oral hygiene. Facilities in this field in Japan are poor and cannot be compared with those of Europe and America. Notable progress has recently been made. There are two representative dental infirmaries for children. The first is the Lion Dental Infirmary for Children, which is the first of the kind in Japan and which has its headquarters in Tokyo. Its establishment, in 1921, was due to Mr. Kobayashi's generosity. Kiyofusa Okamoto and other dentists, both men and women, and oral hygienists gave treatment. The second is that of the Osaka dentists' associations, with headquarters in the Osaka's Citizens' Hall. The Osaka Children's Protective Club has a dental bureau while the Tennoji Citizens' Hall also recently created a children's dental bureau. These are run on the lines of such American institutions as the Forsyth Dental Infirmary for Children and the Rochester Dental Dispensary.

An itinerant dental clinic has also been found to be effective. A dentist is sent out to visit schools and factories for the purpose of inspecting the mouths of students and workers and to give treatment to them. The itinerant dentist often is called on to treat the teeth of elementary school pupils. The Lion Dental Infirmary for Children in Tokyo organized an itinerant dental clinic in 1923, the year of the great earthquake, and it has been very active since that time. The itinerant dental corps commanded the attention of the public by the active part it played during the stormy days following the great

earthquake of 1923. The corps was divided into three groups. The first group established its tent at Kudan; the second group, at Marunouchi, and the third group, at Ueno Park, all in Tokyo. The three groups gave dental treatment to the quake-stricken people of the capital in the wake of the great disaster. In Tokyo, physicians and other dentists organized medical corps and gave first aid to the victims of the earthquake. In Osaka, a similar organization founded by T. Kobayashi and managed by myself, has been sending out an itinerant group since 1924 and has been giving treatment to the needy.

During the period between January, 1921, and March, 1926, the Lion Dental Infirmary for Children spent about 1,472 days in inspecting and giving treatment to patients, numbering 38,216, the total number of treatments being 135,424.

Statistics on Oral Inspection of School Children in Osaka

| | | No. | Per Cent |
|---|---|---|---|
| Number of schools investigated | | 76 | |
| Number of children | | 57,864 | |
| Masticating ability | A | 9,447 | 16 |
| | B | 46,119 | 80 |
| | C | 2,298 | 4 |
| Oral cleanliness | A | 1,831 | 3 |
| | B | 46,442 | 63 |
| | C | 9,591 | 17 |
| Number of children having no decayed teeth | | 7,895 | 14 |
| Number of children having decayed teeth | | 49,969 | 46 |
| Number having 1 decayed tooth | | 5,091 | 10 |
| Number having 2 decayed teeth | | 7,287 | 15 |
| Number having 3-5 decayed teeth | | 16,004 | 32 |
| Number having 6-7 decayed teeth | | 7,299 | 15 |
| Number having 8-10 decayed teeth | | 7,603 | 15 |
| Number having more than 11 decayed teeth | | 6,685 | 13 |
| Number requiring immediate treatment | | 8,880 | 16 |

Dental Caries of First Permanent Molars

| | No. | Per Cent |
|---|---|---|
| Upper right | 3,684 | 7 |
| Upper left | 3,531 | 6 |
| Lower right | 18,469 | 35 |
| Lower left | 18,555 | 35 |

*Oral Inspection of School Children in Osaka.*—The number of the schools visited by the dentists during the period between March, 1924, and March, 1926, is given as eighty-three, while

the number of the pupils inspected is estimated at 99,993.

Many schools throughout the country in recent years installed special rooms in their school houses for dental treatment and engaged dentists to look after the mouths of the pupils. All of the fifteen wards in Tokyo except four have been making appropriations yearly for the improvement of oral conditions among school pupils of each ward, the first appropriation being made in 1920. The Bancho elementary school is equipped with a special room for dental treatment, and the Hongo school also. At present, the Japanese Government is planning to draft a law in cooperation with the Dental Federation of Japan for the supervision of the dental activities in schools.

### SCHOOL ORAL HYGIENE IN THE VARIOUS PREFECTURES OF JAPAN

The first definite step in school oral hygiene in Japanese schools was taken in 1901, when four dentists in one of the wards in Tokyo inspected the teeth of school children in that ward and gave dental treatment. This example was followed in the city of Hiroshima shortly afterwards, where six dentists were employed by schools.

In 1919, a recommendation drawn up by the Dental Federation of Japan concerning the establishment of various facilities for oral hygiene among school children was introduced into the Lower House of the Imperial Diet and was unanimously passed. Following are some of the more important provisions of the recommendation:

1. A government body for investigating matters relating to oral hygiene among children should be established.
2. Mention should be made of oral hygiene in school textbooks.
3. Revision should be made in the law concerning school physicians, looking to the employment in schools of dentists who shall, at least once a year, examine the mouths of the children and make a report to the parents.

In Tokyo, at the instance of the Tokyo City Dentists' Association, a group of school dentists was established in Hongo ward, in 1920, and a school dentists' society has been formed there. Other wards followed. In the City of Nagoya, a dentist has been attached to each elementary schools, numbering eighty-one in 1924, and the Nagoya Oral Hygiene Society has been established. The number of pupils inspected in the year 1924 in this city aggregated 87,819. In Hiroshima, Fukuoka, Kanazawa, Sapporo, Osaka, Kyoto, Wakayama, Niigata and the other principal cities, similar arrangements have been made in rapid succession.

INVESTIGATION BY NAGOYA SCHOOL DENTISTS' SOCIETY

| | |
|---|---|
| Number of school children in Nagoya | 87,819 |
| Number of children having decayed teeth | 68,464 |
| Percentage | 77.95 |
| Number of children | 87,819 |
| Number of children having dental caries of first permanent molars | 39,012 |
| Percentage | 44.43 |
| Number of children | 87,819 |
| Number of children using tooth brush | 43,685 |
| Percentage | 49.74 |

In 1925, the prefectural offices of both Aomori and Saitama issued orders relating to school dentists at the instance of the local dentists' associations.

In the Saitama Prefecture, the following regulations were promulgated in 1925 regarding the system of school dentists:

1. Dentists may be employed by both public and private schools.

2. The founder or manager of a school may employ a dentist after securing consent from the school master and school physician.

3. A school dentist may be discharged by order of the founder or manager of a school. The governor shall have the right to order the founder or manager of a school to discharge a school dentist.

4. A school dentist shall have the full qualifications required by the dental regulations.

5. A school dentist shall execute the matters relating to the oral hygiene of school children under the supervision of the school physician.

6. No salary may be given to a school dentist for a certain period of time.

7. Traveling expenses may be given to a school dentist and the amount shall be the same as that allowed the school master who is classified as a civil official having the rank of hanninkan.

(Other provisions are omitted. It should be noted that the members of the Dentists' Association of Saitama Prefecture have been donating their services to public schools.)

Article 6 of the law concerning oral hygiene in schools promulgated by the Aomori Prefecture, March 20, 1925, provides:

"Public schools may employ those dentists who have full requirements under the dentist regulations. Dentists employed by schools are subject to the regulations to which school physicians are subject."

### PRIZE CONTEST FOR ORAL HYGIENE SLOGAN BY THE DENTISTS' ASSOCIATION

In 1924, the Fukuoka Prefectural Dentists' Association offered a prize for an oral hygiene slogan and chose a slogan "*Mushi-ba wa tuini Hito o kuu*" ("Decayed teeth eat a man eventually") for the first prize, out of 10,520 slogans sent in. Similar contests were held by the Nara and Saitama Prefectural dentists' associations in 1925.

Besides these, oral hygiene campaigns are being carried out by various means by almost all the dentists' associations in Japan, numbering more than 140.

### GOOD TEETH DAY

Under the auspices of the Hanjo and Fukagawa sections of the Tokyo City Dentists' Association, a "Good Teeth Day" was held last fall, and the oral inspection of the school children was carried out, those who have healthy teeth being awarded a prize.

A similar plan has been followed in the other cities, one after another.

### ORAL HYGIENE IN FACTORIES

The first oral hygiene facilities were established in Japanese factories in 1915, when dental clinics were installed in spinning factories. The dental clinic established in the Hoshi Drug Manufacturing Company, Tokyo, in 1923, is the most up-to-date one so far established in Japan. The Kanegafuchi and other spinning factories also have good dental clinics for the treatment of their employes. The Railway Hospital and the Electric Bureau, both in Tokyo, also have dental clinics.

### ORAL HYGIENE IN THE ARMY

The Japanese Army first employed dentists during the Russo-Japanese War of 1904-1905, sending them to the war

zone to give treatment to soldiers. The Army in 1918 established a system by which all the first and second class army hospitals in Japan are allowed to employ dentists. Dental clinics have also been installed in the army hospitals, and the navy yards have dental corps.

### INTEREST IN ORAL HYGIENE

Emotional and artistic appeal in disseminating knowledge about oral hygiene has been found very effective, especially in dealing with children. Interest in oral hygiene should be aroused in the minds of children without impairing its truth and scientific value.

When making an artistic and emotional appeal to children in teaching them oral hygiene, care should be taken to give attention to the practical value of oral hygiene and methods of obtaining benefits therefrom. The following four points should particularly be observed: 1. A strict line should be drawn between the true and the untrue. 2. Respect should be paid scientific truths. 3. A personification of natural forces should not be carried to excess. 4. The need of unity must be recognized. I have written the following fairy tales and songs for children in order to excite their curiosity and interest about the preservation of the health of the teeth: A children's play called "The Tale of the Country of Teeth," in five acts; and fairy tales: "Rabbit's Ear," "Mountain Monkey and City Monkey," and "Jizo-Sama Without Jaws;" children's songs: "The Song of a Devil," and "The Song of Teeth."

Lectures illustrated by moving pictures and lantern slides have been quite successful as the audience gets information through the ears and eyes simultaneously. A set of 100 lantern slides made by Tsurukichi Okumura were used most effectively in the early period of the oral hygiene movement in Japan, and is now kept by the Dental Federation of Japan as a souvenir. Ten reels of moving pictures entitled "Mouth Hygiene" which I took for illustrative purposes in 1923, under the management of the Lion Oral Hygiene Department, are now being utilized extensively throughout Japan.

### PAMPHLETS AND OTHER PRINTED MATTER

Propaganda through the medium of printed matter has been also very effective. This method has been used in our country since the earliest period of the movement, and there are several thousands different kinds of printed matter. Perfection in the form and content of the literature is an essential condition for the success of this sort of propaganda.

### ORAL HYGIENE PUBLICATIONS

The Dental Federation of Japan has published the various booklets and charts and its oral hygiene section is publishing the more valuable booklets in series. Besides, there are several periodicals, such as the *Japan Oral Hygiene*, the *Radan*, published by the Children Welfare Club of Osaka, and the *Shiroi Tama*, after the style of fairy tales.

The most notable textbook on oral hygiene is "Oral Prophylaxis" by T. Okumura, published by the Tokyo Dental College. T. Kawakami has written a book called "Twelve Lectures on Oral Hygiene," and has edited a book which is known as the "Source Book on Oral Hygiene." The oldest book on oral hygiene in Japan was published in 1898 by B. Shikata, of Matsue. He published several pamphlets on the same subject. The Lion Dental De-

partment, which I have been superintending, has published a number of pamphlets on oral hygiene since 1910.

GROUPS FOR STUDY OF ORAL HYGIENE

Various groups for the study and investigation of matters relating to oral hygiene have been created in the general social evolution. At present, there are the following groups in our country:

The Oral Hygiene Investigation Society, established in 1919 by the Dental Federation of Japan and composed of forty members. Its purpose is to investigate matters relating to oral hygiene.

The Association for Preventing Decayed Teeth, established in 1924 in Tokyo, with members throughout the country. It publishes a periodical *The J. O. H.*, under the editorship of Hajime Takatsu, and its object is to study matters relating to the oral hygiene movement. The Nagoya and Nagano prefectures have established similar associations.

The Lion Oral Hygiene Department, was established in 1913 by Tomijiro Kobayashi, with headquarters in Tokyo. It is the largest of such institutions in Japan and its purpose is to study oral hygiene and to participate in the oral hygiene movement. Both the Lion Dental Infirmary for Children and the Lion itinerant dental corps are attached to this institution.

The Nakayama Oral Hygiene Laboratories, established by Taichi Nakayama in 1922, in Tokyo and Osaka, under the supervision of Tamejiro Kawakami and Matsutaro Hamano. Their purpose is to study oral hygiene and participate in the oral hygiene movement, installed with the itinerant dental corps.

PEDODONTIA ASSOCIATION OF JAPAN

The Pedodontia Association of Japan was established in Tokyo in 1925 by the pedodontists of the country, and others interested in children's dentistry. The association publishes an annual pamphlet.

ORAL HYGIENE DEMONSTRATION

Many public functions and demonstrations of oral hygiene have been held in Japan, but by far the largest was "Decayed Teeth Day," which was observed, Nov. 5, 1920, in Tokyo, under the joint auspices of the Dental Federation of Japan and the Tokyo Dentists' Association. On that day, the entire student body of all dental colleges and schools in Tokyo distributed hand bills throughout the city in motor cars, creating great interest among the citizens. This affair was so successful that it was immediately followed by similar demonstrations in Fukuoka and other large cities in Japan.

There are at present more than 10,000 dentists in Japan, and they have been contributing toward the welfare of humanity by these methods. There is one point which I wish to emphasize in particular. In 1915, the oral hygiene movement was actually started in Japan; and it was in the same year the same movement in the United States showed great activity.

I have no doubt that the future progress of oral hygiene depends on cooperation among all those engaged in the study and propagation of this branch of science and also on the efforts of scholars of the world engaged in research into the various phases of this science. I hope for the success of this movement throughout the world.

## CHILD HEALTH MEETING IN WASHINGTON IN MAY

The annual meeting of the American Child Health Association will be held this year in Washington, D. C., May 9-11, with headquarters at the Hotel Willard.

The theme of this year's meeting, in the words of the Association's president, Herbert Hoover, is "to evaluate gains made, to take stock of resources, to delineate the course ahead."

Among the topics to be discussed will be "The Contributions of Research to Child Health," "Self Analysis of Health Organizations," "The Cost of Health Protection," "Significance of Health to the School Beginner," "Adjusting Education to the Child's Physical and Mental Abilities" and "The Promotion of Health through Recreation." Many of the national associations concerned with recreation and character training of boys and girls are sending representatives to participate in the conference, and to discuss with physicians, nurses, educators and public health officers, ways and means of securing closer cooperative effort.

The railroads have granted the usual fare and a half privilege on the certificate plan.

## ANNOUNCEMENT OF SUMMER SCHOOL FOR DENTAL HYGIENISTS—1927

The University of Buffalo, for the second year, is offering a six weeks' postgraduate summer course for dental hygienists. This is designed to fill the apparent need and desire of dental hygienists for instruction in subjects which will assist them in presenting their work to both adults and children. By the advice and through the cooperation of the New York State Department of Education, the following course has been arranged:

Education (principles of teaching)
Child psychology
Public speaking
Applied oral hygiene (field problems)
Nutrition

Other related courses in education are available and may be substituted for any of the above already taken.

Stanley R. Meaker, supervisor of oral hygiene in the State Department of Education, will have charge of the course. Other instructors include Daniel H. Squire, dean of the School of Dentistry, University of Buffalo and various members of the faculty; Miss Olive Lester, instructor in the University of Buffalo; Miss Mary C. Boardman, dental hygienist, and Mrs. George Skinner, dental hygienist.

As a credit of six semester hours will be given for this course, it is anticipated that boards of education will feel disposed to allow the customary increase in salary as for teachers taking advanced work. A tuition fee of $42 will be charged, and the regular registration fee of $3. Board and lodging expenses will average $12; laundry and incidentals, $3 to $5 a week.

Classes will be held daily except Saturdays beginning at 8:30 a. m. from July 5 to August 13 as a part of the regular summer school of the university. Clinical demonstrations will be given at the University of Buffalo, School of Dentistry and other institutions.

Extensive provisions have been made by the university for entertainments and excursions of pleasurable and educational value.

Further information can be obtained on request to Dr. Daniel H. Squire, dean of the School of Dentistry, University of Buffalo or Dr. Stanley R. Meaker, State Education Department, Albany, N. Y.

## BABY PACIFIERS PROHIBITED

An order of the Mexican Federal Department of Public Health prohibits the importation and manufacture of baby pacifiers on the ground that they are a menace to the health of babies. The department has sent out instructions to mothers warning them as to the need for the perfect sterilization of nipples used by artificially fed babies.—Bol. d. Depart. de Salubridad Pub., Mexico City.

# Announcements

## CALENDAR OF MEETINGS*

### NATIONAL SOCIETIES

American Academy of Periodontology, October 20-22, 1927, Detroit, Michigan.

American Dental Assistants Association, October 24, 1927, Detroit, Michigan.

American Dental Hygienists Association, October 24-28, 1927, Detroit, Michigan.

American Dental Association, October 24-28, 1927, Detroit, Michigan.

American Medical Association, May 16-20, 1927, Washington, D. C.

American Society of Oral Surgeons and Exodontists, October 21-22, 1927, Detroit, Michigan.

American Society of Orthodontists, May 2-5, 1927, Chicago, Illinois.

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American Dental Society of Europe, August 1-3, 1927, Paris.

Canadian Dental Association, May 16-19, 1927, Toronto, Canada.

European Orthodontological Society, July 21-22, 1927, London, England.

International Dental Federation, August 6-9, 1927, Copenhagen.

Sixth Australian Dental Congress, August 22-27, 1927, Melbourne, Australia.

### STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

#### May (1927)

Arkansas, at Hot Springs (9-11).
Illinois, at Peoria (10-12).
Indiana, at Indianapolis (16-19).
Iowa, at Des Moines (3-5).
Maryland, at Baltimore (2-4).
Massachusetts, at Boston (2-6).
Missouri, at St. Louis (23-26).
Nebraska, at Omaha (16-19).
New York, at Buffalo (18-20).
Pennsylvania, at Pittsburgh (10-13).
South Carolina, at Columbia (9-11).
South Dakota, at Sioux Falls (9-11).
Tennessee, at Memphis.
Texas, at Austin (10-13).
Vermont, at Burlington (25-27).
Virginia, at Virginia Beach (9-11).
West Virginia, at Martinsburg (16-18).

#### June (1927)

Colorado, at Colorado Springs (15-18).
Georgia, at Albany (15-17).
Idaho, at Pocatello (13-15).
Maine, at Belgrade Lakes (21-23).
Mississippi, at Gulfport (16-18).
New Hampshire, at Plymouth (8-10).
New Mexico, at Roswell.
Oregon, at Portland (20-23).
Wyoming, at Thermopolis (20-21).

#### July (1927)

Porto Rico, at San Juan.
Wisconsin, at Milwaukee (12-14).

#### October (1927)

Florida, at St. Petersburg.

#### December (1927)

Ohio, at Cleveland (2-4).

#### February (1928)

Minnesota, at Minneapolis (Feb. 29-March 2).

#### April (1928)

California, at Stockton (9-12).

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### MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, June 27, 1927. Secretary-Treasurer, E. W. Patton, 725 First

*Announcements must be received by the ninth of the month in order to be published in the forthcoming issue of THE JOURNAL.

National Bank Building, Birmingham, Alabama.

California, at San Francisco, May 28, 1927, and Los Angeles, June 25, 1927. Secretary, O. E. Jackson, 155 Kentucky Street, Petaluma, California.

Connecticut, at Hartford, June 23-25, 1927. Recorder, A. B. Holmes, Waterbury, Connecticut.

Delaware, at Wilmington, June 15-16, 1927. Secretary, W. S. P. Combs, Middleton, Delaware.

District of Columbia, at Georgetown University Dental School, June 14-18, 1927. Secretary-Treasurer, C. Willard Camalier, Medical Science Building, Washington, D. C.

Indiana, at Indianapolis, June 13, 1927. Secretary, J. M. Hale, Mt. Vernon, Indiana.

Iowa, at Iowa City, May 31-June 3, 1927. Director, H. W. Grefe.

Kansas, at Wichita, June 13, 1927. Secretary, George E. Burket, Kingman, Kansas.

Kentucky, at Louisville, June 17, 1927. Secretary, J. H. Baldwin, 980 Francis Building, Louisville, Kentucky.

Maine, at Augusta, June 23-25, 1927. Secretary, G. W. MacKay, Millinocket, Maine.

Maryland, at Baltimore, June 1-3, 1927. Secretary, T. L. McCarriar, 1822 N. Charles Street, Baltimore, Maryland.

Massachusetts, at Boston, June 14-17, 1927. Secretary, W. Henry Grant.

Michigan, at Ann Arbor, June 13-18, 1927. Secretary, J. W. Lyons, 617-21 Dwight Building, Jackson, Michigan.

Minnesota, at Minneapolis, June 16-26, 1927. Secretary, F. E. Cobb, 601 Donaldson Building, Minneapolis, Minnesota.

Missouri, at St. Louis, June 8-11, 1927. Secretary, George E. Haigh, Central Trust Building, Jefferson City, Missouri.

New Jersey, at Trenton, June 27-July 1, 1927. Secretary, John W. Forsyth, 148 W. State St., Trenton, New Jersey.

New Mexico, at Roswell, June 16-18, 1927. Secretary, J. J. Clarke, Artesia, New Mexico.

North Carolina, at Raleigh, June 20, 1927. Secretary, H. O. Lineberger, Raleigh, North Carolina.

Ohio, at Columbus, June 27-July 2, 1927. Secretary, Ray R. Smith, 327 E. State Street, Columbus, Ohio.

Oklahoma, at Oklahoma City, June 20-23, 1927. Secretary-Treasurer, Carles A. Hess, Idabel, Oklahoma.

Pennsylvania, at Philadelphia and Pittsburgh, June 22-25, 1927. Secretary, Alexander H. Reynolds, 4630 Chester Avenue, Philadelphia, Pennsylvania.

Rhode Island, at Providence, June 28-30, 1927. Secretary, Albert L. Midgley, 1108 Union Trust Building, Providence, Rhode Island.

South Dakota, at Sioux Falls, June 27, 1927. Secretary, G. G. Kimball, Mitchell, South Dakota.

Tennessee, at Memphis, June 20, 1927. Secretary-Treasurer, F. W. Meacham, 911 Hamilton National Bank Building, Chattanooga, Tennessee.

Texas, at Dallas, June 6-9, 1927. Secretary, D. C. Johnson, Atlanta, Texas.

Vermont, at Montpelier, June 27-29, 1927. Secretary, David Manson, Burlington, Vermont.

West Virgina, at Charleston, June 28, 1927. Secretary, C. H. Neill, 206 Professional Building, Fairmont, West Virginia.

Wisconsin, at Milwaukee, June 13-18, 1927. Secretary, S. F. Donovan, Tomah, Wisconsin.

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National Association of Dental Examiners, at Detroit, Michigan, October 22, 1927. Secretary-Treasurer, George L. Powers, Memphis, Tennessee.

## CALIFORNIA STATE DENTAL SOCIETY

The California State Dental Society will meet April 9-12, 1928, at Stockton.

## GEORGIA STATE DENTAL SOCIETY

The fifty-ninth annual meeting of the Georgia State Dental Society will be held June 15-17, at Albany.

G. A. MITCHELL, *Secretary*,
Candler Bldg.,
Atlanta, Ga.

## IDAHO STATE DENTAL ASSOCIATION

The Idaho State Dental Association will hold its annual meeting at Pocatello, June 13-15.

H. B. COLVER, *Secretary*,
Boise, Idaho.

## MISSISSIPPI DENTAL ASSOCIATION

The Mississippi State Dental Association will meet in Gulfport, June 16-18.

A. S. HOPKINS, *Executive Committeeman*,
Gulfport, Miss.

## NEW HAMPSHIRE DENTAL SOCIETY

The fiftieth anniversary of the New Hampshire Dental Society will be celebrated June 8-10, at Pemigewassett House, Plymouth.

C. J. WASHBURN, *President*,
Concord, N. H.

## OREGON STATE DENTAL ASSOCIATION

The thirty-fourth annual meeting of the Oregon State Dental Association will be held in Portland, June 20-23, inclusive. Percy R. Howe of Boston, Mass., and T. M. Maves, Cleveland, Ohio, will be guests of the association. O. T. Wherry is president of the association. Essays are in charge of L. J. Fitzpatrick and Fred Bleeg is chairman of the clinic committee.

ARTHUR F. WEEKS,
*Chairman of Publicity*.

## BOARD OF DENTAL EXAMINERS OF ALABAMA

The Board of Dental Examiners of Alabama will hold the regular dental and hygienic examinations in Birmingham, commencing Monday, June 27, at 9 a. m. All credentials must be in the hands of the secretary-treasurer at least two weeks before the above-mentioned date. Blanks will be furnished on application to

E. W. PATTON, *Sec'y-Treas.*,
725 First National Bank Bldg.,
Birmingham, Ala.

## BOARD OF DENTAL EXAMINERS OF CALIFORNIA

The Board of Dental Examiners of California will conduct examinations for a license to practice dental hygiene and a license to practice dentistry, in San Francisco, commencing May 28, and for the practice of dentistry, in Los Angeles, June 25. Complete credentials, together with the required fee of $25, must be in the hands of the secretary at least twenty days before the examinations. Personal checks are not accepted.

O. E. JACKSON, *Secretary*,
155 Kentucky St.,
Petaluma, Calif.

## DELAWARE BOARD OF DENTAL EXAMINERS

The next meeting of the Delaware Board of Dental Examiners will be held in the Municipal Building, Tenth and King streets, Wilmington, June 15-16, from 9 a. m. to 5 p. m. For further information, address.

W. S. P. COMBS, *Secretary*,
Middleton, Del.

## BOARD OF DENTAL EXAMINERS OF THE DISTRICT OF COLUMBIA

The next examination for dentists and dental hygienists by the Board of Dental Examiners of the District of Columbia will be held, June 14-18, at the Georgetown University Dental School. Information and application blanks can be secured from

C. WILLARD CAMALIER, *Sec'y-Treas.*,
Medical Science Bldg.,
Washington, D. C.

## MARYLAND STATE BOARD OF DENTAL EXAMINERS

The regular semi-annual meeting of the Maryland State Board of Dental Examiners will be held, Wednesday-Friday, June 1-3, beginning at 9 a. m., at the Baltimore College of Dental Surgery, University of Maryland School of Dentistry, Lombard and Greene streets, Baltimore. For further information, blanks, etc., address

T. L. MCCARRIAR, *Secretary*,
1822 N. Charles St.,
Baltimore, Md.

## MASSACHUSETTS BOARD OF DENTAL EXAMINERS

The Massachusetts Board of Dental Examiners will hold an examination for registration for both dentists and oral hygienists in the City of Boston, June 14-17. Full information, application blanks, etc., can be

secured at the office of the secretary, Room 146, State House, Boston. All applications must be filed at the office of the secretary at least ten days before the date set for the examination.

W. HENRY GRANT, *Secretary.*

## MINNESOTA STATE BOARD OF DENTAL EXAMINERS

The Minnesota State Board of Dental Examiners will hold the next meeting at the College of Dentistry, University of Minnesota, June 16-26. Applications for examination must be in the hands of the secretary, June 1.

F. E. COBB, *Secretary,*
601 Donaldson Bldg.,
Minneapolis, Minn.

## MISSOURI DENTAL BOARD

The next meeting of the Missouri Dental Board will be held at the Washington University, St. Louis, June 8-11. For further information address

GEORGE E. HAIGH, *Secretary,*
Central Trust Bldg.,
Jefferson City, Mo.

## NEW MEXICO STATE DENTAL BOARD

The New Mexico Board of Dental Examiners will hold its next meeting, June 16-18, at Roswell. For additional information, address

J. J. CLARKE, *Secretary,*
Artesia, N. Mex

## THE OHIO STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Ohio State Board of Dental Examiners will be held in Columbus, June 27-July 2, for the purpose of granting licenses to practice dentistry and oral hygiene in the State of Ohio. The oral hygiene examination will be given Tuesday, June 28. For further information and application forms, write to

RAY R. SMITH, *Secretary,*
327 E. State St.,
Columbus, Ohio.

## OKLAHOMA STATE BOARD OF DENTAL EXAMINERS

The Oklahoma State Board of Dental Examiners will hold its next meeting for the purpose of examining applicants, June 20-23, inclusive, at Oklahoma City, State Capital Bldg.

CHARLES A. HESS, *Sec'y-Treas.,*
Idabel, Okla.

## SOUTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the South Dakota Board of Dental Examiners will be held in Sioux Falls, beginning Monday, June 27.

G. G. KIMBALL, *Secretary,*
Mitchell, S. Dak.

## TENNESSEE BOARD OF DENTAL EXAMINERS

The Tennessee Board of Dental Examiners will meet at 9 a. m., June 20, at the Dental Department, University of Tennessee, Memphis, for the purpose of examining all applicants who present credentials acceptable to the board of dental examiners. Hygienists will also be examined. Bring credentials to the board meeting for examination by the entire board. Applications should be in the hands of the secretary five days before the board meeting. For applications and clinical requirements, address

F. W. MEACHAM, *Sec'y-Treas.,*
911 Hamilton National Bank Bldg.,
Chattanooga, Tenn.

## VERMONT BOARD OF EXAMINERS

The Vermont State Board of Dental Examiners will meet at Montpelier, June 27-29, to examine applicants for license to practice dentistry and dental hygiene. Applications, together with the examination fee of $25, must be in the hands of the secretary not later than June 15. Candidates will present for registration and preliminaries at 11 a. m., Monday, June 27. For further information, address

DAVID MANSON, *Secretary,*
Burlington, Vt.

## WISCONSIN BOARD OF DENTAL EXAMINERS

The next examination by the Wisconsin State Board of Dental Examiners for the purpose of granting licenses to practice dentistry and oral hygiene in the State of Wisconsin will be held at Marquette Dental College, Milwaukee, June 13-18, 1927. Applications must be on file ten days before examination. For further information and application blanks, address

S. F. DONOVAN, *Secretary*,
Tomah, Wis.

## AMERICAN DENTAL HYGIENISTS ASSOCIATION

The next meeting of the American Dental Hygienists Association will be held in conjunction with the American Dental Association in Detroit, Mich., October 24-28.

ETHEL F. RICE, *Secretary*,
721 N. University Ave.,
Ann Arbor, Mich.

## INTERN—POSITION OPEN

The position of dental intern at the Lenox Hill Hospital, New York City, will be vacant, September 1. The term of service is one year, with full maintenance. Apply in writing not later than April 15 to

GEORGE F. SAUER, *Supt.*,
112 East 77th St.,
New York City.

## NOTICE TO PEDODONTISTS

To enhance our general knowledge of children's dentistry and more easily disseminate this knowledge to the profession and public at large, we are anxious to get in touch with all pedodontists. If you are limiting your practice to this phase of dentistry, please forward your address to the Detroit Pedodontic Society.

SAMUEL D. HARRIS, *Secretary*,
412 Kresge Bldg.,
Detroit, Mich.

## DINNER FOR DR. OWRE

You are cordially invited to attend a dinner given in honor of Alfred Owre, D.M.D., M.D., C.M., B.A., F.A.C.D., Wednesday evening, May 25, at 7 o'clock, Radisson Hotel, Minneapolis. Dr. Owre has for twenty-two years been dean of the University of Minnesota College of Dentistry. He is dean elect of Columbia University, College of Dentistry.

## ST. LOUIS COLLEGE OF DENTISTRY MARION-SIMS DENTAL COLLEGE ST. LOUIS UNIVERSITY DENTAL SCHOOL

### GRADUATES HOMECOMING

On May 24, during the week of the Missouri State Dental Meeting in St. Louis, a general Homecoming is being arranged at the St. Louis University Dental School, Grand and Caroline Aves., for all the Graduates of the foregoing consolidated colleges. Among other things will be a banquet, to be given by the dental school to the alumni. It is expected that hundreds of the old graduates will take advantage of this opportunity to visit the school and renew old associations.

## ALUMNI ASSOCIATION, COLLEGE OF PHYSICIANS AND SURGEONS OF SAN FRANCISCO

The annual meeting of the Dental Alumni Association of the College of Physicians and Surgeons of San Francisco, a School of Dentistry, will be held at the College, Monday-Tuesday, May 23-24, 1927. Clinics will be presented on every phase of dental practice. George M. Hollenback, of Los Angeles, will lecture and demonstrate "Inlays and Modern Crown and Bridgework." A luncheon meeting will be held at the Hotel Whitcomb, Tuesday, May 24, at which William Ophuls, dean of the School of Medicine, Stanford University, will speak on "Medicodental Relationship."

FREDERICK T. WEST, *Chairman*,
Publicity Committee,
2595 Mission Street,
San Francisco, Calif.

## COMMONWEALTH OF PENNSYLVANIA DEPARTMENT OF PUBLIC INSTRUCTION STATE BOARD OF DENTAL EXAMINERS

The next regular examination of the Pennsylvania State Dental Council and Examining Board will be held in Philadelphia and Pittsburgh, Wednesday-Saturday, June 22-25. The theoretical examination will be held in the hall at 808 Locust St., Philadelphia, and at the University of Pittsburgh, Pittsburgh. The practical examination will be held at the Evans Dental Institute, Philadelphia, and the University of Pittsburgh, Pittsburgh, Saturday, June 25, at 8:30 a. m. An examination will be held in the fundamental branches for students who complete their second year in June, Wednesday-Thursday, June 22-23. An examination will also be held for dental hygienists at the same places, Thursday-Saturday, June 23-25.

Application papers may be secured from the Department of Public Instruction, Harrisburg. For further information, address

ALEXANDER H. REYNOLDS, *Secretary*,
4630 Chester Ave.,
Philadelphia, Pa.

## BOOK REVIEWS

*Sound Teeth in a Sound Body.* By Frederick Malcolm Wells, D.D.S., L.D.S., Late Research Officer Canadian Army Dental Corps. With plates. 128 pages. Published by the author, 36 Crescent Street, Montreal, Canada.

This book deals largely with the subject of diet as it affects the teeth and bones. The author fed guinea-pigs various diets and noted the results. He says: "The outstanding facts of the whole series are: That ordinary white bread fed to guinea-pigs in addition to wheat, bran, feed oats, and whole cow's milk autoclaved for two hours at 120 C, causes death from scurvy within 24 days; while the same flour and ingredients in the bread, supplemented by prepared wheat germ incorporated during bread-making, entirely protects against scurvy."

He treats of the subject of rickets as caused by defective diets, and shows many illustrations made from photographs in 1919 in Vienna, nearly a year after the war. The whole question of diet is claiming much attention at this time, and any effort to extend our knowledge of the subject is to be welcomed.

*A Text-Book of Exodontia.* By C. Dudley Gwinn, D.D.S., Assistant Professor of Oral Surgery, University of California, San Francisco, California; Visiting Dentist to the French Hospital, San Francisco; member of the Staff of the Stanford University School of Medicine, San Francisco, California. 73 Illustrations. 242 pages. Price $2.75. Published by Lea & Febiger, Philadelphia.

The object of this book, as stated by the author, is to provide a guide for the student in extraction, rather than for the advanced operator. In the present age when the economy of time is very important, the thing which appeals to the reader in examining Dr. Gwinn's book is its compactness. And yet he has apparently covered the subject in sufficient detail to give the student an intelligent idea of the various operations, and in the beginning of the book he has even found space to devote a chapter to the history of extraction of teeth. The volume will be found useful, convenient and not expensive.

*Dental Materia Medica and Therapeutics,* With Special Reference to the Rational Application of Remedial Measures to Dental Diseases. A Text-Book for Students and Practitioners. By Hermann Prinz, A. M., D.D.S., M.D., Sc.D., Professor of Materia Medica and Therapeutics, The Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; Member of the U. S. Pharmacopeia and Formulary Committee, American Dental Association. Sixth edition enlarged and revised according to the United States Pharmacopeia, Tenth Decennial Revision. 146 illustrations. 632 pages. Price $6.00. Published by C. V. Mosby Company, St. Louis, Mo.

A new edition of this well-known work will be welcomed by the profession. It is now nine years since the fifth edition was issued, and in that time sufficient change has occurred to render necessary a revision of most of the chapters. In a book of this size and character, it is difficult to select all of the significant features for especial notice, but in view of the present extensive advocacy of tooth pastes, powers and washes, the chapter on "Preparations for the Mouth and Teeth" will be found of particular interest. Another subject treated in considerable detail,

as would be expected, is that of "Antiseptics." which occupies more than ninety pages.

Dr. Prinz never treats anything in a haphazard manner, and the reader may therefore approach his book with the assurance that the subject matter has received a serious and painstaking consideration.

*Fundamental Principles of a Systemic Diagnosis of Dental Anomalies*, By Dr. Paul W. Simon, Head of the Department of Orthodontics, of the Dental Institute of the University of Berlin. Translated by Dr. B. E. Lischer. 378 pages, 189 illustrations. Published by The Stratford Company, Boston, Mass.

The American edition of this work is brought out under the auspices of the American Society of Orthodontists. The science of orthodontia is constantly assuming a more commanding position among the specialties of dentistry, and any book which deals seriously with this subject must claim the attention of the thinking men of the profession. The present volume is controversial to a high degree, but sometimes out of controversy comes the truth. In the past, there have been two "schools" or theories which governed the practical procedures of orthodontists, the one taking as its basis the idea that "the maxillary first molars, and consequently the maxillary denture, is always in a fixed and normal position in the skull," and that "the best results in the face are always obtained when all the teeth are in place and in normal occlusion." This hypothesis has been opposed by others claiming that "the maxillary denture is in varying positions anterior and posterior to certain fixed points in the skull, which are little influenced by the developmental growth of the denture" and that "the hypothesis that the best results in the face are always obtained when all the teeth are in place and in normal occlusion is false."

Dr. Simon's book contends vigorously for the latter conception, and goes into great detail and many measurements to prove his point. With this as with every other problem in the process of evolution, the truth must ultimately prevail, and until the truth is definitely established, every orthodontist owes it to himself and his patients to read and study all the literature bearing on the subject.

## PATENTS OF INTEREST TO DENTISTS

1494448. Toothbrush, Joseph Sookne, New York, N. Y.

1495673. Portable dental engine for an all-cord elbow arm and handpiece, Bacon L. Cliffton, Los Angeles, Calif.

1495675. Dental instrument, Eydna T. Colt, Long Beach, Calif.

1495732. Toothbrush, Edwin H. Gibb, Nutley, N. J.

1495390. Dental occlusal device, Jeptha G. Hollingsworth, Kansas City, Mo.

1495586. Manufacture of dental plates, Christe Joannides, Constantinople, Turkey.

1495958. Film holder for dental purposes, David J. Machol, West New Brighton, N. Y.

1495533. Roentgen-ray tube, Otto A. Roensch, Newark, N. J.

1495443. Container for dental burs and the like, William Rosser, Cleveland, Ohio.

1496204. Amalgam mixer, Josef Brandstetter, Chicago, Ill.

1495997. Artificial tooth, Ernst Frantz, Hoboken, N. J.

1496412. Tooth holder, John H. Hammann, Tottenville, N. Y.

1496541. Rubber dam clamp, James W. Ivory, Philadelphia, Pa.

1496238. Removable bridge-plate attachment, Charles W. Lokey, Birmingham, Ala.

1496426. Sterilizer for dental handpieces, Peter J. L. Nemmers, Chicago, Ill.

1496168. Tooth-carding device, Lafayette Pickering, Columbus, Ohio.

1496429. Dental casting machine, Clarence O. Pollen, Tacoma, Wash.

1497495. Toothbrush, Leo I. Fincke, Chicago, Ill.

1497561. Sanitary shield for dental engine handpieces, Francis J. Gruss, San Francisco, Calif.

1497514. Preparing dental inlays, Karl W. Knapp, Des Moines, Iowa.

1497749. Dental tool, Alexander S. Diack, Detroit, Mich.

1498283. Dental tool holder, Wm. A. Kelsey, Minneapolis, Minn.

1498285. Dental appliance, William Lorenz, Niagara Falls, Canada.

1497759. Dental tool, Robert W. Lowe, Holyoke, Mass.

1498219. Mouth prop for dentists, John A. Williams, Fort Wayne, Ind.

## AMERICAN DENTAL ASSOCIATION

Detroit, Mich. Oct. 24-28, 1927.

### HOTEL RESERVATIONS

In securing hotel reservations for the 1927 Session, consult the hotel rate-sheet and fill out the blank application below. Mail it immediately to the hotel that you wish to patronize. The hotel will then advise you of the reservation which they make for you.

WILLIAM T. BURKE,
*Chairman*,
Halls and Hotels,
507 Fine Arts Bldg.,
Detroit, Mich.

Keep this reminder of your reservation.

Hotel selected .....

No. of Rooms .....

No. of Persons .....

Date of reservation ..... 1927.

Detach here and keep the above for reference.

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## MAIL THIS APPLICATION DIRECT TO HOTEL

### HOTEL RESERVATION

AMERICAN DENTAL ASSOCIATION, DETROIT, MICH., OCT. 24-28, 1927.

..... HOTEL ..... 1927.
Detroit, Mich.

Please reserve sleeping room accommodations noted below:

..... Room (s) with bath for ..... people. Rate Desired $ .....
(per day)

..... Room (s) without bath for ..... people. Rate Desired $ .....
(per day)

I hereby agree to pay for room described from morning of October ..... to October ..... unless cancellation is made by Oct. 1, 1927.

*List of names and addresses who will occupy room with you:*

Name ..... Address .....
*Street, City and State.*

Name ..... Address .....
*Street, City and State.*

Name ..... Address .....
*Street, City and State.*

## HOTEL ROOM RATES—DETROIT

| HOTEL | Rooms | WITH BATH | | WITHOUT BATH | |
|---|---|---|---|---|---|
| | | One Person | Two Persons | One Person | Two Persons |
| BOOK-CADILLAC<br>Michigan and Washington Blvd. | 1,200 | $4.00 | $6.00 | | |
| STATLER<br>Grand Circus Park | 1,000 | 3.00 | 5.00 | | |
| TULLER<br>Grand Circus Park | 800 | 2.50 | 5.00 | | |
| SAVOY<br>Woodward and Adelaide | 750 | 2.50 | 4.00 | | |
| DETROIT-LELAND<br>Cass and Bagley | 700 | 3.00 | 5.00 | | |
| BARLUM<br>Cadillac Square and Bates | 810 | 2.50 | 4.00 | | |
| FORT SHELBY<br>Lafayette and First | 393 | 3.00 | 4.50 | $2.50 | $3.50 |
| FORT WAYNE<br>Cass and Temple | 300 | 2.50 | 5.00 | | |
| IMPERIAL<br>26 Peterboro | 170 | 3.00 | 5.00 | | |
| MADISON-LENNOX<br>Madison Ave. | 300 | 2.50 | 4.00 | 2.00 | 3.00 |
| NORTON<br>Jefferson and Griswold | 250 | 2.75 | 4.50 | 2.00 | 3.50 |
| PALMETTO<br>John R. and Hancock | 324 | 3.50 | 5.00 | | |
| PRINCE EDWARD<br>Windsor, Ontario, Canada | 250 | 3.00 | 6.00 | | |
| ROYAL PALM<br>2305 Park Ave. | 180 | 3.50 | 5.00 | | |
| STEVENSON<br>46 Davenport | 207 | 2.50 | 4.00 | | |
| WEBSTER HALL (*Bachelor*)<br>111 Putnam | 766 | 3.00 | | 2.00 | 4.00 |
| WOLVERINE<br>Witherell and Elizabeth | 500 | 2.50 | 5.00 | | |
| FAIRBAIRN<br>Columbia and John R. | 450 | 2.50 | 4.00 | 1.50 | 3.00 |
| PARK AVENUE<br>Park and Sproat | 250 | 3.50 | 5.00 | | |
| PAUL REVERE<br>67 Sproat | 360 | 2.50 | 3.50 | 2.00 | 3.00 |
| PLAZA<br>166 Madison | 100 | 2.50 | 3.50 | | |
| WARDELL APTS<br>15 E. Kirby Ave. | 165 | Apts. $65.00 per month and up | | | |

# DEPARTMENT OF LITERARY RESEARCH

ESTABLISHED BY

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